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Annual report of the Vermont Agricultural Experiment ...

Vermont Agricultural Experiment Station

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FROM

The Station

UNIVERSITY OF VERMONT

AND STATE AGRICULTURAL COLLEGE

SEVENTEENTH

ANNUAL REPORT

OF THE

VERMONT AGRICULTURAL

EXPERIMENT STATION

BURLINGTON, VT.

1903-1904

BURLINGTON :
FREE PRESS ASSOCIATION,
PRINTERS, BINDERS, STATIONERS.
1905.

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THE VERMONT

Agricultural Experiment Station,

BURLINGTON, VT.

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ANNOUNCEMENT

The "State Agricultural Experiment Station" was established in accordance with an act of the General Assembly of 1886, "for the promotion of scientific and practical agriculture in connection with and under the control of the University of Vermont and State Agricultural College." For the past seventeen years it has received the funds appropriated by Congress under the provisions of the act approved March 2, 1887. The State appropriation expired in 1890. An appropriation "not to exceed $1,000 annually" was made by the legislature of 1898 for the purpose of printing the annual report, and one of $500 by the legislature of 1902 to defray the expenses incurred in the inspection of feeding stuffs.

The Station is prepared to analyze and test fertilizers, feeding stuffs for domestic animals, seeds, milk and other agricultural materials and products—exclusive of water and human foods, which should be sent to the State board of health laboratory, Burlington,—to identify fruits, grasses, weeds, blights, insects, etc., and to give information on various subjects connected with agriculture for the use and benefit of the citizens of Vermont. The identification or analysis of minerals does not lie within the province of Station activities. Such samples and inquiries should be sent to the State geologist, Burlington.

All chemical analyses, etc., of agricultural materials proper to an Experiment station, that can be used for the public benefit, are made without charge, so far as time and means permit. The Station will undertake no work the results of which are not at its disposal to use or publish, if deemed advisable for the public good. The results of such analyses will be promptly communicated to the party sending the sample. Those that are of general interest are published.

It is the wish of the Board of Control to make the Station as widely useful as its resources will permit. Every Vermont citizen who is concerned in agriculture, whether farmer, manufacturer or dealer, has a right to apply to the Station for any assistance that comes within its province to render, and it will respond so far as lies in its power. All communications relating to agriculture, horticulture, plant or animal diseases, insects, etc., will be fairly considered, and, so far as possible, promptly answered.

The main station building is located on Main street at the south end of the College park. The farm and its buildings are on the Williston road, adjoining the University grounds on the east. Electric cars pass at Colchester avenue and University Place, within a third of a mile of the station building. Both the Station and the farm have telephone connections.

Instructions for taking samples of fertilizers, fodders, milk, seeds, etc., will be sent on application. Parties desiring to send samples should first write for these directions. Many samples received are useless, being incorrectly drawn. Parcels by express, to receive attention, should be prepaid and should bear the address of the shipper for purposes of identification.

Copies of the reports and bulletins of the Station are sent free of charge to any address on application.

Address all communications, not to individual officers, but to the

EXPERIMENT STATION, BURLINGTON, VT.

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FINANCIAL REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 1904

Vermont Agricultural Experiment Station, in account with the United States Appropriation, 1903-1904.

DR.

To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1904, as per act of Congress approved March 2, 1887..............$15,000 00

CR.

	Abstract		
By Salaries	1	$7,361 92	
" Labor	2	2,837 74	
" Publications	3	1,168 64	
" Postage and stationery	4	438 07	
" Freight and express	5	121 24	
" Heat, light and water	6	372 86	
" Chemical supplies	7	124 04	
" Seeds, plants and sundry supplies	8	154 63	
" Fertilizers	9	140 15	
" Feeding stuffs	10	1,022 40	
" Library	11	44 59	
" Tools, implements and machinery	12	43 90	
" Furniture and fixtures	13	2 19	
" Scientific apparatus	14	176 97	
" Live stock	15	38 63	
" Traveling expenses	16	263 31	
" Contingent expenses	17	18 25	
" Building and repairs	18	670 47	
			$15,000 00

We, the undersigned, duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the Vermont Agricultural Experiment Station for the fiscal year ending June 30, 1904; that we have found the same well kept and classified as above, and that the receipts for the year from the treasurer of the United States are shown to have been $15,000, and the corresponding disbursements $15,000, for all of which proper vouchers are on file and have been by us examined and found correct.

And we further certify that the expenditures have been solely for the purposes set forth in the act of Congress approved March 2, 1887.

Signed,

{SEAL}

MATTHEW H. BUCKHAM,
CASSIUS PECK,
GARDNER S. FASSETT,
} Auditors.

Attest,
E. HENRY POWELL,
Custodian.

Receipts and disbursements under No. 83 of the Acts of 1902 (fertilizer law); No. 84 of the Acts of 1902 (feeding stuffs law); No. 81 of the Acts of 1898 (creamery inspection law); for the fiscal year ending June 30, 1904:

DR.

A.	To license fees received from fertilizer companies and forwarded to State treasurer	$2,430 00	
	Add amount not drawn on July 1, 1903	$127 70	
			$2,557 70
B.	To State appropriation for feeding stuffs inspection	500 00	
	Add amount not drawn upon July 1, 1903,	409 01	
			$ 909 01
C.	To balance on hand last report	9 00	
	To receipts from applicants for licenses	31 00	
	To receipts from supply houses, creameries and cheese factories for testing Babcock glassware	143 45	
			$ 183 45

CR.

	A.	B.	C.
By Salaries	$1,019 30	$142 75	$......
" Labor	63 76	16 23	145 17
" Publications	646 22	144 40	......
" Postage and stationery	24 86	26 65	1 06
" Freight and express	23 15	1 80	2 94
" Heat, light and water	54 50	10 00	......
" Sundry supplies	......	......	19 78
" Chemical supplies	247 53	6 30	......
" Library	9 00	......	......
" Traveling and sampling expenses	460 15	120 63	......
" Contingent expenses	......	2 00	5 11
Add amounts forwarded to State treasurer against which no expenditures were incurred prior to July 1, 1904	9 23	......	......
Add amount not drawn upon June 30, 1904	......	438 25	......
Add balance on hand unexpended	......	......	9 39
	$2,557 70	$909 01	$183 45

REPORT OF THE DIRECTOR

J. L. Hills

The present report covers the work of the Station during the past fiscal year, July 1, 1903, to June 30, 1904. The nine bulletins issued during that time, Nos. 100 to 108, inclusive, as well as the annual report, are both indexed in the latter on pages 368 and 369.

PUBLICATIONS

Nine bulletins and the sixteenth annual report, aggregating 554 pages of printed matter, have been issued during the year in editions of 12,000 to 14,000. Abstracts of the regular bulletins appear on pages 377-382. A list of publications issued during the year follows:

1903.		
August,	No. 100.	Paying for separator cream at the creamery, 24 pages.
September,	No. 101.	Commercial feeding stuffs, 8 pages.
October,	No. 102.	The measurement of saw logs, 8 pages.
December,	No. 103.	The maple sap flow, 144 pages.
December,	No. 104.	Commercial feeding stuffs, 8 pages.
1904.		
February,	No. 105.	The maple sap flow, 32 pages.
March,	No. 106.	Abstract of sixteenth annual report, 48 pages.
April,	No. 107.	Commercial fertilizers, 24 pages.
June,	No. 108.	Commercial fertilizers, 60 pages.

Many of the back bulletins and reports of the Station are nearly or quite out of print. Parties having spare copies of any of the publications noted in the following list would confer a favor by returning the same to the Station, thus enabling it to comply with requests from libraries and from other stations. Postage will be refunded to the sender on request.

All of the Station reports except the 3d, 13th, 14th *and* 16th, *Bulletins* 1 to 11 *inclusive*, 15, 16, 18, 19, 20, 22, 25, 28 to 34 *inclusive*, 36 to 40 *inclusive*, 42, 44, 45, 49 to 52 *inclusive*, 54, 56, 57, 59 to 63 *inclusive*, 65, 66, 69, 71 to 76 *inclusive*, 81, 83, 85, 90, 100.

PUBLICATIONS ON HAND

The Station has issued to the date of distributing this report, including the present number, 17 annual reports and 110 bulletins. Many of these are out of print. The following numbers are in print, and will be sent on request without charge as long as the supply lasts:

1888,	April.	No. 12, Insecticides; seed tests; miscellaneous analyses	16 pages
	November.	No. 13, Method of cutting and planting potatoes; fertilizer analyses	12 pages
		No. 14, Analyses of fertilizers licensed for sale in the State of Vermont for the year 1888	16 pages
1889,	October.	No. 17, Test of dairy cows at Vermont state fair	18 pages
		Third annual report (Commercial fertilizers, water analyses, feeding trials with cows, fodder crops, horticultural and entomological matter.)	178 pages
1890,	September.	No. 21, A new milk test; testing milk at creameries and cheese factories; notes for the laboratory	32 pages
1891,	March.	No. 23, Analyses of fertilizers licensed for sale in the State of Vermont for the year 1891	16 pages
	May.	No. 24, Potato blight and rot	16 pages
	September.	No. 26, Maple sugar	24 pages
1892,	January.	No. 27, Tests of dairy apparatus	12 pages
1893,	May.	No. 35, Analyses of fertilizers licensed for sale in the State of Vermont for the year 1893	16 pages
1894,	May.	No. 41, Analyses of commercial fertilizers	16 pages
	November.	No. 43, Household pests	8 pages
1895,	March.	No. 46, Analyses of commercial fertilizers	16 pages
	May.	No. 47. Commercial fertilizers	40 pages
	October.	No. 48, Gluten feeds and meals	20 pages
1896,	August.	No. 53, The pollination of plums	20 pages
	December.	No. 55, Apple growing in Grand Isle county	16 pages
1897,	April.	No. 58, Analyses of commercial fertilizers	16 pages
1898,	April.	No. 64, Analyses of commercial fertilizers	16 pages
	December.	No. 67, Hybrid plums	30 pages
1899,	January.	No. 68, Inspection of milk tests and feeding stuffs	8 pages
	April.	No. 70, Analyses of commercial fertilizers	16 pages
	October.	No. 73, The trees of Vermont	54 pages
1900,	March.	No. 76, The forest caterpillar	28 pages
	April.	No. 77, Analyses of commercial fertilizers	24 pages
		No. 78, Analyses of commercial feeding stuffs	24 pages
		No. 79, Analyses of commercial fertilizers	12 pages
	May.	No. 80, Analyses of commercial fertilizers	48 pages
		No. 82, Analyses of commercial feeding stuffs	26 pages
1901,	January.	No. 84, Analyses of commercial feeding stuffs	16 pages
	March.	No. 86, Analyses of commercial fertilizers	24 pages
		Thirteenth annual report	258 pages

		(Potato diseases, weed killing, bacterial vegetable rots, plum propagation, plum and apple pollination, composition of potatoes and of artichokes, feeding trials with cows, food effect on butter quality, herd records).	
	May.	No. 87, Analyses of commercial fertilizers	48 pages
	October.	No. 88, Analyses of commercial feeding stuffs	16 pages
	November.	No. 89, Plum culture	12 pages
	December.	No. 90, Apple growing in Addison county	8 pages
1902.		Fourteenth annual report (Potato diseases, apple rots, grasses, weed killing, plum propagation, hybrid plums, apple inventory of Grand Isle county, nitrogen free extract matter of potatoes and of artichokes, organic nitrogen availability, testing Babcock glassware, feeding trials with cows, comparisons of feeding trial methods, food effect on butter quality).	234 pages
	February.	No. 91, Analyses of commercial feeding stuffs	16 pages
	April.	No. 92, Analyses of commercial fertilizers	24 pages
	May.	No. 93, Commercial fertilizers	54 pages
	May.	No. 94, Vermont grasses and clovers	48 pages
	June.	No. 95, A poisonous plant—the common horsetail	8 pages
	September.	No. 96, Apple pomace a good feed for cows	8 pages
	September.	No. 97, Analyses of commercial feeding stuffs	16 pages
1903,	March...	No. 98, Analyses of commercial fertilizers	24 pages
	May.	No. 99, Commercial fertilizers	88 pages
	August.	No. 100, Paying for separator cream at creameries.	24 pages
	September.	No. 101, Commercial feeding stuffs	8 pages
	October.	No. 102, The measurement of saw logs	8 pages
	December.	No. 103, The maple sap flow	160 pages
	December.	No. 104, Commercial feeding stuffs	8 pages
1904,	February.	No. 105, The maple sap flow	32 pages
		Sixteenth annual report (Plant diseases, potato maladies and their prevention, weeds, the shrubby cinquefoil, apple tree borers, mushrooms, fertilizer analyses, dairy husbandry, including feeding trials, herd records, etc.)	190 pages
	March.	No. 106, Abstract of sixteenth report	48 pages
	April.	No. 107, Commercial fertilizers	24 pages
	June.	No. 108, Commercial fertilizers	68 pages
	September.	No. 109, Commercial feeding stuffs	8 pages
	December.	No. 110, Commercial feeding stuffs	12 pages

RELATION OF THE STATION TO THE PUBLIC

The Station seeks to promote the agricultural interests of Vermont in a five-fold manner:

1. By the scientific investigation of matters pertaining to agriculture and the publication of the results of its experimental work in

the form of bulletins and reports, and also through the medium of the agricultural, scientific and general press.

2. By sampling, analyzing and reporting the quality of the sundry commercial fertilizers, feeding stuffs, etc., sold in Vermont, and by supervising certain matters relating to the conduct of the milk-test system at creameries and cheese factories.

3. By direct correspondence with individuals of all classes, particularly with farmers, and by the personal contact of members of the Station staff with the farming community at institutes, fairs, through visitation, etc.

4. By analyzing miscellaneous agricultural materials in accordance with section 263 of the Vermont statutes.

5. By so conducting its farming operations that visible and tangible evidence may be shown of the usefulness of science in agriculture; or, in other words, by affording daily object lessons in good modern farming.

1. *Publications.*—The determination and dissemination of new and useful facts of an agricultural bearing is the main function of the Station.

It makes an attempt to reach its constituency in many ways, and it is felt that it is yearly becoming more useful. The passage of an act by the legislature of 1898 appropriating one thousand dollars annually for printing permits of a larger use of printer's ink than heretofore. For instance, such bulletins as 81 on the "Principles and Practice of Stock Feeding," 94 on "Vermont Grasses and Clovers," and 100 on "Paying for Separator Cream at Creameries" could hardly have been issued had it not been for this fund. The sum is a fair offset against expenses incurred in complying with section 263 V. S.

2. *Inspection work.*—This line of work serves in some degree to put the traffic in commercial fertilizers and feeding stuffs and the milk-testing practice of creameries and cheese factories on a higher plane. It is conducted under State laws.

3. *Correspondence.*—Considerable inroads upon the time of the director and of other members of the staff are made by the daily correspondence. It is, however, a legitimate line of service, which is helpful to the farmer, and is gladly undertaken. The personal contact of Station workers with the farmers is highly desirable. In few ways can the results of Station endeavors be brought home more directly to the farmer, or his needs and perplexities be more clearly realized by the scientist than by their meeting at the institute, in the field or by visitation. The director was an active member of the State

board of agriculture for fourteen years, and Station representatives address from 20 to 40 farmers' institutes annually.

4. *Miscellaneous analytical work.*—Section 263 of the Vermont statutes requires the Station to analyze without charge materials of an agricultural nature. Parties intending to make use of the Station in this way are respectfully referred to the statements in the announcement on page 367. Attention is called to the fact that the Station no longer makes water analyses, a class of work now done at the laboratory of the State board of health. Mineral analyses, human food analyses (other than milk and milk products), the investigation of cases of suspected poisoning, etc., are likewise outside its province. Questions concerning mineral resources should be sent to the State geologist, Prof. G. H. Perkins, Burlington; those having to do with poisoning should be referred to the State's attorney of the county in which the alleged poisoning occurred. Analyses of human food are made in the laboratory of the State board of health at Burlington.

5. *The Station farm.*—The farm and buildings are open to the inspection of all who may be interested therein. Visitors are welcome on week days to look over the buildings and stock. The kindly words of approval from thousands of visitors in the past show that the object lessons in good farming, the experiments which appeal to the eye, and the information elicited by direct questioning of those in charge alike prove helpful.

RELATION OF THE STATION TO THE STATE

The income of the Station is derived from several sources, including the congressional grant, State printing appropriation, license fees from commercial fertilizer companies, appropriation for feeding stuffs inspection, creamery glassware and operators' fees, and sale of farm produce. The financial reports showing the expenditures of several of these funds are printed on pages 368-369. It is to be noted that the State laws require the Station to do a class of work, which, while unquestionably of much value to the farming interests, is held by the government officials to be outside the province of the national enactment. Hence it is that the funds derived from the congressional grant cannot be used for such purposes and recourse must be had to other sources of income.

WORK OF THE YEAR

Full statements of the main results of station endeavor during the past year published in this report (not in bulletins) in the departments of botany, horticulture, chemistry, and dairy husbandry are made under appropriate headings in the following pages.

Copies of the bulletins abstracted in the following pages will be sent without charge to any address on application.

ABSTRACTS OF BULLETINS

BULLETIN 100—PAYING FOR SEPARATOR CREAM AT THE CREAMERY

By J. L. Hills

Dairymen who sell hand separator cream to creameries often fail to receive their just dues, owing to faulty sampling, testing and accounting.

Suggestions are made as to sampling methods. The moderate warming of the sample and the use of a fine sieve and pestle are urged as means of promoting its more thorough mixing and its accurate analysis.

The absolute necessity of testing a full 18 grams of cream is emphasized. Eighteen cubic centimeters measured in the pipette seldom deliver 18 grams into the test bottle. Weighing the cream into the test bottle is the only known means whereby accuracy may be attained. A modification of the cream-testing process, which has some vogue—i. e. the analysis of cream heated to 140-150° F., results being modified according to a table of correction factors,—has been tried but did not approve itself.

A larger "surplus" is due to patrons who furnish cream than to those who deliver milk. A higher price per pound of butter or of butterfat is similarly their due. The extra "surplus" may be as low as 2.5, or, in very exceptional cases, as high as 5 percent. It averages 3 percent. The extra price naturally varies, but usually is close to a half cent. The reasons why cream patrons should be thus favored are discussed at length, and examples are cited.

Several examples of the sundry methods of determining milk-fat and cream-fat surpluses, of calculating payments on the "butter basis," or the "butter-fat basis," etc., are given in the appendix.

BULLETINS 101 AND 104—COMMERCIAL FEEDING STUFFS

By J. L. Hills, C. H. Jones and F. M. Hollister

Cottonseed meals were generally found to be up to guaranty. About half of the linseed goods failed to meet guaranty. The gluten byproducts as usual were as a rule below guaranty. The distillers' dried grains, made from the corn crop of 1902, were as good as they were guaranteed to be, while those made from that of 1903 were not. The oat feeds were as good as they were said to be—sometimes; and often they were not. A few provenders and wheat offals were found to be adulterated. Cottonseed feed meal was offered in the spring of 1903 to some extent. Several condimental feeds were analyzed and their general composition discussed.

BULLETIN 102—THE MEASUREMENT OF SAW LOGS

By A. L. DANIELS

This bulletin discusses a formula for determining in advance of its sawing the actual number of board feet in an average log. Attempts in this direction have been made heretofore, and, as a result, over two score so-called "log rules" have more or less vogue in different localities, some, indeed, being enacted into state laws. There seems reason for thinking that the "Universal log rule" discussed in this bulletin is in many ways a distinct advance over any of its predecessors, and worthy of the attention of parties who deal in logs.

BULLETIN NO. 103—THE MAPLE SAP FLOW

By C. H. JONES, A. W. EDSON and W. J. MORSE

This 144-page publication obviously cannot be epitomized in a paragraph. Some of the points of particular economic importance are summarized in the abstract of its popular edition—No. 105.

BULLETIN No. 105—THE MAPLE SAP FLOW

By J. L. HILLS

The matter appearing in this bulletin is in part a reprint, in part a condensation, and in part a reshaping of Bulletin 103, a 144-page technical exposition of the causes and effects of maple sap pressure and flow by C. H. Jones, A. W. Edson and W. J. Morse. Realizing that so long a treatise, written moreover largely for the scientific reader, was not the best form in which to present the practical outcome of the study to the general public, this bulletin has been prepared for that purpose. The larger one will be sent without charge to any one who expresses a desire for it, and specifies it by its number, 103.

1. SUMMARY

The results of several seasons' work in the sugar bush point to the following conclusions as to sundry matters pertaining to the maple sap flow:

1. *Whence comes the sugar and what relation has the structure of the tree and its life functions to sugar formation?*—Maple sugar is formed from starch in the late winter and early spring. This starch is stored in certain sap wood cells during the preceding summer and is probably transformed into sugar through the action of enzymes. The starch is formed in the leaves under the influence of sunlight. A large leaf area and plenty of sunshine conduce to sugar making. The reverse conditions hinder it.

2. *What is the cause of the sap flow?*—The immediate cause of the flow from the tap hole is sap movement under pressure towards the point of least resistance. The exciting cause of this flow seems to be temperature fluctuations back and forth over the 32° F. line, causing alternation of pressure and suction, a pumplike action. The ultimate and absolute cause can hardly be this or any other physical one. It probably is a function of the living cell. (See Bulletin 103 for full discussion).

3. *What relations to the sap flow are borne by weather changes, the water and gas contents of the tree, pressure and suction, and direction of sap movement?*—The maple trunk rapidly accumulates water during the late winter and early spring. It at all times contains much gas enclosed within the cell walls of the woody tissues. The sap passes through these walls readily; gas, scarcely at all. Moreover, temperature changes cause expansion or contraction of the volume of imprisoned gases, and changes in pressure of the imprisoned gases. Increase of water content and rising temperature produce pressure, pressure induces sap movement, and sap movement means sap flow. Alternations of temperature above and below freezing, cause alternate conditions of pressure and suction, and bring about a pumplike action which accounts in some measure for the intermittent flow. Pressure comes from above and below the tap hole, but little from the side. The sap flow comes, under ordinary conditions, chiefly from tissues directly above and below the tap hole.

4. *What bearing has location of the tree and variations in tapping on the amount and character of the flow?*—Trees in the open give more and richer sap than those further back in the bush, crowded and shaded, because of greater leaf expansion and sun exposure. No more sugar is yielded by tapping on the "branchy" side of a tree than on that relatively devoid of branches. A difference of but 4 pounds

in 1,000 was noted in favor of the side which was well filled out. Without exception more sugar was obtained from the outer 1.5 inches than from tissues deeper in the trees.

Four-fifths of the sugar yielded from a tap hole 6 inches deep came from the first or outer 3 inches of wood tissue. The remaining fifth would not compensate for the extra labor of boring and increased injury to the tree.

On typical sap days a tap hole on the south side yielded the most sugar, but on other days, particularly if cloudy, when all sides of the tree warmed more equally, the outcome between taps on different sides of the tree was more uniform.

No decided advantage arises from a too careful selection of any particular side for tapping. The best results will be secured by selecting a point that does not show the nearby marks of recent tappings.

The sap obtained from the customary tapping height (4 feet) was found to be greater in quantity and better in quality than that from the root (at ground level) or higher on the tree (14 feet above the ground).

Twenty-seven percent of the total sugar yielded came from the root tap, 51 percent from the main tap and 22 percent from the high tap hole. The high tap hole ceased running earlier in the day than did the others.

The larger the tap hole the more sap and sugar for a time at least. It is undesirable, however, so to wound the tree that the hole will not soon heal over. A ⅜ to ⅝ inch sharp bit is recommended for tapping. The hole should be free from shavings, borings, etc., before the spout is inserted.

The spout selected should not obstruct the wood tissues of the tree, should securely hold the pail and should be easily inserted and removed. The bark should largely contribute to the firm holding of the spout.

5. *What is the extent and cause of sap variation?*—Sixty-three percent of the sap drops before noon. There is a slight betterment in its sugar content as the day advances. As between orchards there are large variations. In five cases 2.08 and 3.44 percents were extremes. In the same place in consecutive years the sugar contents were 2.14 and 2.42 percents while the average sugar content in sap flowing from the experimental trees was 3.13 and 3.41 percents. This was not due to a selection of trees but to rain water and snow. A third of the entire liquid gathered, hauled and evaporated was rain and snow water. The expense of handling this material would pay the cost of pail covers in a short time.

6. *What draft does an average sugar yield make upon the total sugar content of a tree?*—Provided three pounds of sugar be made to the tree, from 4 to 9 percent, according to the size of the tree, is removed.

BULLETIN No. 106—ABSTRACT OF SIXTEENTH ANNUAL REPORT

This bulletin, an abstract of the sixteenth report, a volume of about 200 pages, contains statements concerning plant diseases, potato maladies and their prevention, weeds (particularly the dangerous shrubby cinquefoil of Bennington county), apple tree borers, mushrooms, fertilizer analyses, and dairy husbandry, including feeding trials, herd records, etc. The matter having to do with plant diseases and weeds is abstracted from the report of the botanists, L. R. Jones and W. J. Morse; the borer article is briefed from the horticulturist's report by William Stuart; the statements as to mushrooms, infant foods and fertilizers, from the pen of the chemist, C. H. Jones; while the dairy husbandry matter was the work of the director, J. L. Hills. No abstract is given, as such would prove either inadequate or overlong.

BULLETINS 107 AND 108—COMMERCIAL FERTILIZERS

By J. L. HILLS, C. H. JONES and F. M. HOLLISTER

Results of inspection.—The Station has drawn from dealers' stocks and analyzed 118 of the 123 licensed brands, the output of ten companies, all 1904 goods.

Quantity of plant food.—Eighty percent of the brands met their guaranties. Three brands failed to afford a commercial equivalent of their promises. One serious case of misshipment is discussed at some length. The average fertilizer carried 9 percent more plant food than it was said to contain. Its composition is somewhat poorer than it was in 1903.

Quality of plant food.—The quality of the crude stock used was found almost invariably to be above reproach. A few criticisms, however, may be made. A third of the brands, mostly the low grade and low priced goods, carried no water-soluble nitrogen. An inferential claim, that sulphate of potash was used, appears on three-fourths of the brands; it was actually used in but a sixth of them. The organic nitrogen used, with possibly one or two exceptions, seems to have been of good quality.

Selling prices and valuations.—The average selling price was $29.00, the average valuation, $18.47. One dollar in three spent for mixed fertilizers was paid to the manufacturer, railroad, and selling agent for their work, while only two of the three paid for plant food. But 57 cents' worth of plant food was bought for a dollar in average low grade goods, and 62 cents' worth in medium grade goods. The average high grade brand, however, afforded 72 cents' worth for a dollar. Some Vermont buyers paid twice as much for plant food as did others.

A classification of the brands sold in Vermont on the basis of their guarantied plant food contents is offered as an aid to purchasers in making an intelligent commercial choice.

A cursory summary is made of the effects upon the character of farm manures of the food and care of the animal, stable construction and management, the use of absorbents, etc. The causes and prevention of manurial waste are also briefly reviewed, followed by a short discussion of the use and application of manures.

A comparison of analyses of brands for five years shows in some cases essential evenness and in others considerable variation in composition. The tables showing composition for five years should prove helpful to the early buyer of mixed goods.

REPORT OF THE BOTANISTS

L. R. Jones and W. J. Morse

Owing to the absence of the botanist during the past summer, attention in this department has been largely confined to the continuation of work already under way. Report is herewith presented upon the following subjects:

Occurrence of Plant Diseases in Vermont in 1904.

Potato Diseases and their Remedies.

I. Results from spraying potatoes in 1904.
II. Relation of date of digging to development of rot.
III. Does liming prevent rot?
IV. Disinfection of scabby potatoes by formaldehyde gas.

An Inspection of Grass and Clover Seed.

OCCURRENCE OF PLANT DISEASES IN VERMONT IN 1904

WEATHER CONDITIONS

Since the development of plant diseases is largely influenced by weather conditions, the following tables[1] are inserted, which give a summary from the weather records for Burlington and Northfield covering the growing period. The Burlington record represents fairly well the conditions in the Champlain valley and in the southern part of the State, while the Northfield record probably indicates quite closely the conditions in the northern and central parts.

	Mean temperature	Mean temperature for 21 years	Total rainfall	Average total rainfall for 21 years	Number clear days	Number cloudy days	Number partly cloudy days	Date killing frost
Burlington								
May	60.9	58.6	2.99	3.12	20	6	5	..
June	65.2	67.8	2.37	3.36	12	7	11	..
July	69.0	71.5	4.19	3.91	11	14	6	..
August	66.7	68.8	2.56	4.14	17	10	4	..
September	57.8	61.8	5.84	3.59	8	12	10	23
Average for 5 months	63.9	65.7	3.59	3.62	..	..	..	..
Total..........	....	....	....	....	68	49	36	..

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[1] The Station is indebted to Mr. W. B. Gates, voluntary observer at Burlington, and to Mr. W. A. Shaw, observer at Northfield of the Weather Bureau of the United States Department of Agriculture, for the records.

NORTHFIELD		For 18 yrs.		For 18 yrs.				
May	57.1	53	2.30	2.67	11	8	12	..
June	60.6	62	1.33	3.12	7	10	13	..
July	64.0	66	3.53	3.59	2	11	18	..
August	60.9	63	3.54	3.89	9	9	13	..
September	53.2	56	5.06	2.83	9	16	5	23
Average for 5 months	59.1	60	3.15	3.22	..	..	..	..
Total	....	....	....	....	38	54	61	..

It will be seen from the above tables that omitting May, the mean temperature month by month was from one and one-half to four degrees lower than the average for the last two decades. The mean temperature for the entire five months was nearly two degrees lower than the average for the last 21 years at Burlington and nearly one degree lower than the average for the last 18 years at Northfield. The rainfall of May and the total for the five months was about up to the average. The total rainfall for the three summer months was two and one-quarter inches less and of the month of September two and one-quarter inches more than the average of the two decades. The effect of this cool dry midsummer period was in general to reduce the loss from parasitic fungi, and of the excessive rainfall of September to induce an unusual amount of potato rot.

POTATO BLIGHT

During the months of August and September potato fields were examined in many points in northern and central Vermont. Almost without exception there was an abundance of strong, healthy tops, but somewhat late in development. This latter condition was partly due to late planting and partly to the low temperature and comparative dryness of the summer months.

Considerable arsenical poisoning was noted, which in every case investigated was found to be due to improper methods of application. In some localities, especially on the sandy soils near Burlington, early blight was very destructive. Many fields, particularly where the foliage had been weakened by tip-burn and improper use of arsenites, were entirely destroyed by this fungus early in August.

Late blight did not appear as early as usual, being ten days later than in 1903 and over a month later than in 1902. The first blighting leaves were observed in Burlington on August 21 and in Irasburg on August 23. From this time on through September it developed very slowly and though widely reported, did less damage to the foliage than usual. Consequently the gain in total yield from spraying potatoes with bordeaux mixture was below the average. However, as a protection against the dry rot of the tuber, resulting from late blight, the returns from spraying were highly satisfactory, as will appear later.

While spraying did not serve as a preventive of early blight, apparently much less damage was done by this fungus to sprayed than to unsprayed plants.

DISEASES OF FIELD CROPS

Occasional blighted leaves have been observed in the corn fields of the Station farm for the past two years. Examination showed the trouble to be due to the fungus *Helminthosporium inconspicuum*, C. & E. While blighting leaves were not uncommon, serious damage seldom occurred. During the past season, however, one field was quite thoroughly infested by this fungus. Nearly every leaf in some parts of the field showed one or more blighted areas, and without doubt the value of the crop was materially lessened as a result.

ORCHARD DISEASES

Apple and pear scab seemed more prevalent than in the preceding year. Considerable damage both to foliage and plants occurred with susceptible varieties which were not protected by spraying.

A twig blight and apple canker were found in one large orchard, due apparently to the attacks of a parasitic fungus, the nature of which has not as yet been determined.

By far the most serious injury to Vermont orchards during the year was caused by the peculiar weather conditions of the winter of 1903-4 and, possibly, of the preceding summer. From the middle of April, 1903, to the first week in June an unbroken drought obtained throughout the East. As a result, while the trees put forth foliage as usual, there was no real active growth till after the rains came in June. Consequently the growing season was shortened and, doubtless, much of the wood failed to mature. Such wood was ill-fitted to endure the winter weather of 1903-04, one of the most severe seasons that has been experienced in Vermont in years.

During May and early June, 1904, the Station was constantly importuned from all parts of the State as to a peculiar trouble affecting apple, pear, plum and cherry trees. In most cases correspondents reported that the trees began to put forth foliage and often blossomed profusely. As this stage was reached, however, the flowers suddenly began to drop off and the leaves to wither and die. An examination of the small twigs where the leaves had begun to dry up showed, on following the branch down, a depression where the cambium was dead. The bark appeared shrunken and withered. The dead cambium often extended to the larger branches and frequently, in the case of young, actively growing trees, to the base of the trunk itself. Trees in this condition were observed by one of the writers all through the central and eastern part of the State and as far south as northern Massachusetts. Professor W. T. Macoun of the Central Experimental Farm, Ottawa, in correspondence reports many trees injured in this manner and large numbers of them killed outright, as was also the case in Vermont. An examination of the diseased trees in many orchards led to the conclusion that the trouble was due to winter killing. The trees most badly affected were usually in the more exposed locations. The Station horticulturist also gave attention to this malady and makes brief statements concerning proposed remedial treatment in his report.

GARDEN VEGETABLES AND SMALL FRUITS

No reports were received as to the prevalence of soft rots of vegetables. There was an outbreak of bacterial rot of turnip in the station garden in 1903. Turnips and cabbages were planted on the same area in 1904 to see whether the disease would reappear. It did so, indicating that the organisms remain in the soil in destructive numbers.

The red rust of the blackberry and asparagus rust were very prevalent during the past season, much more being observed than for several years past. A blackberry cane blight (*Gloeosporium, sp.*) was reported from the southern part of the State.[1]

POTATO DISEASES AND THEIR REMEDIES

I. RESULTS FROM SPRAYING POTATOES IN 1904

This makes the fourteenth consecutive year in which records have been kept at this Station of the results obtained from the use of bordeaux mixture for spraying potatoes. As in 1903 one application made between the 10th and the middle of August was sufficient to protect the foliage from late blight. However, where another application was made during the last week in August or the first of September there was much gain resulting from the protection of the tubers from rot caused by the late blight fungus.

Records as to results obtained from spraying potatoes were kept on parts of three different fields. Field number one was a somewhat sandy loam which had been in grass for several years. A heavy dressing of manure was plowed under in early spring. No commercial fertilizer was used. It was designed to plant early in May, but as circumstances prevented the ground being fitted at that date, these plots were planted on May 28. The variety used was Delaware, at the rate of sixteen bushels per acre, the seed having been previously disinfected for scab by soaking in formalin solution. One application of paris green was made on the entire field about July 10. On July 26 and on August 25 rows 4, 5, 6, 10, 11 and 12 received thorough applications of standard bordeaux-paris-green mixture. Rows 1, 2, 3, 7, 8 and 9 were sprayed at the same time with paris green in water, the amount of this poison being the same on all rows.

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[1] This may be *Gloeosporium navioulisporum*, Stoneman. The spores are similar in appearance to those of *G. nariculisporium*, but Miss Stoneman reports that some of these measure twice the length of those of that species.

A careful record of the growth and the condition of the tops was kept during the growing season. By July 20 the plants were about one foot high and beginning to blossom. On August 20 the vines were very large and healthy, two feet or more in length and nearly covering the ground. No early or late blight was found, and the plants still showed a few flowers. The sprayed and unsprayed foliage looked entirely alike at this date. Early blight began to develop during the first week in September, and, on September 6, the unsprayed rows showed more early blight and tip burn on nearly every hill. The sprayed rows were quite healthy on this date. On September 20 the foliage on the unsprayed rows was two-thirds dead from early blight and tip burn. A small amount of late blight could be seen on the unsprayed rows at this time. The sprayed portions were quite healthy, with a few leaves on each hill showing early blight. The plants on the entire field were killed by frost on September 23.

The crop was allowed to remain in the soil until October 15 before digging. At this time there was no indication that any of the tubers had entirely decayed, in fact few were very badly decayed. Therefore, the results given for the total yield is probably very near the exact figure. In this connection it may be well to call attention to certain facts already stated, namely, that no manure was used except that which was plowed under in early spring; that the crop had almost no care whatever, except spraying; and that owing to the lateness of planting, the growing season of the crop, three months, was very short. However, returns from the sprayed portion were far better than those from the average Vermont potato field. The same may be said in a less degree of the unsprayed portion; but had the blight appeared as early as it has frequently in the past it is safe to say that the crop would hardly have paid for harvesting.

Following are the results stated in bushels per acre:

	Total yield	Sound tubers	Decayed tubers	Percent of decay
Sprayed	294	293¾	¼	0.1
Unsprayed	234	204	30	13.
Gain	60	89¾	..	...

Field number two was a part of the main potato field of the Station farm. It had been in corn for two years, and for three years, including the present, had received a liberal application of stable manure. No commercial fertilizer was used. The soil resembled that in field number one, being, however, somewhat less sandy and slightly more moist.

The variety used was Delaware, planted May 25. The piece received the same attention that the remainder did, both as to hoeing and to spraying, which were done by the regular farm help. The crop was sprayed twice, August 5 and September 1. At the time of the first spraying a portion of the field as near like the adjoining as possible was left unsprayed. Until killed by frost on September 23 the plants were in a fairly healthy condition, although on account of the lateness of the season they had begun to weaken considerably towards the last. Some early blight and considerable injury from flea beetles and other small insects were noted. The sprayed portions appeared to have been less troubled by insects than the unsprayed. The unsprayed rows were just beginning to develop late blight, although it had not progressed far enough to do material damage to the foliage or even to be apparent to the average observer.

The plots were not dug until October 28, when the following results were obtained, expressed in bushels per acre:

	Total yield	Sound tubers	Decayed tubers	Percent of decay
Spryaed	370	370	0	0
Unsprayed	368	320	48	13
Gain	2	50	..	..

Field number three was a clay loam soil, and consisted of about one-third acre, located on one of the most travelled highways leading in the city, admirably situated for use as an object lesson in spraying. The seed—variety unknown—was planted about the middle of May. The plants were in fine condition and very uniform all over the piece by the first of August. Sixteen out of twenty-four rows were sprayed twice with standard bordeaux mixture on August 9 and September 5. The first blight was seen on the unsprayed rows on August

21, but the progress of the disease was exceedingly slow all through the month of September. On September 23 the plants were all killed by frost. At this date at least 90 percent of the leaves on the sprayed rows were alive, the remainder having been killed mainly by insect injuries and early blight. No late blight was seen on any of these. Fully 95 percent of the foliage on the unsprayed rows had been killed, largely by late blight.

The plots were dug on October 3. The sprayed and unsprayed portions for the record were carefully selected to secure uniformity of conditions and the two outside rows where the sprayed and unsprayed plots joined were rejected. The results, calculated in bushels to the acre, are as follows:

	Total yield	Sound tubers	Decayed tubers	Percent of decay
Sprayed	344	317	27	8
Unsprayed	301	56	245	81
Gain	43	261	..	..

The following gives a summary of the results obtained from the three different spraying experiments:

	Total yield in bushels per acre		Increased total yield in bushels per acre	Rot in bushels per acre		Net gain from spraying in bushels per acre
	Sprayed	Unsprayed		Sprayed	Unsprayed	
Field No. 1	294	234	60	¼	30	90
Field No. 2	370	368	2	0	48	50
Field No. 3	344	301	43	27	245	261
Average	336	301	35	9	108	134

DISCUSSION OF THE RESULTS

The gain in the total yield was not so large as usual. This was due to the very late appearance of the blight. Early potatoes were all out of the way and, in most cases, the late varieties had nearly reached their maturity before they were attacked. Even then the progress of the disease was so slow that it was only a slight check upon the growth of the crop. Much spraying done in Vermont during the season of 1904 was probably done at a loss, when considered as foliage protection only. This was the case in field number two, while fields number one and three paid a fair profit on the investment. On the other hand the results attest in a remarkable way to *the value of spraying as a protection against the rot of the tuber.* This is well shown in the records for field number three, where the sprayed portion yielded 317 bushels of sound tubers per acre and the unsprayed only 56 bushels per acre. This gives a net gain as a result of spraying of 261 bushels per acre, or 466 percent gain. When the crop was dug potatoes were selling in Burlington at from 50 to 60 cents per bushel. This makes an increase of from $130 to over $156 per acre in the value of the crop obtained. This is, to be sure, an exceptional case; but we learned of several fields during the fall where the rot was as bad, and in some instances where it was worse, than this. A few reports were received where the owners did not consider the crop worth the cost of digging. The Station farm raised over 1,700 bushels fit for table use on less than five acres of land. The soil on at least half of this field was practically the same as on field three. The crop was sprayed twice. Little or no rot was found when dug and the potatoes readily brought 60 cents per bushel in the city.

Why should there be so much less late blight of the foliage and so much more loss from rot this year than usual? Probably the explanation is to be found in the weather conditions of the season. Leaf disease was held back by the dry growing period of June, July and August, and the tuber rot was promoted by the wet September. There were only eight clear days during that month, and rain fell on fourteen days. Nearly one-third of the rainfall from May 1 to October 1 occurred in September. The precipitation was 5.84 inches or 2.25 inches more than the average for this month for the last twenty years. The mean temperature was also four degrees below the average for the last twenty-one years. The soil was continually soaked with water, with no sunshine to dry out the surface. This furnished admirable conditions for the falling spores to infect the tubers near the surface. It is a significant fact that the amount of rot found per acre in each field is more or less proportionate to the length of time in which the blight had been developing on the foliage. Field number three, when it had been established over a month, gave 245 bushels of rotted tubers, while on fields one and two, where it had just appeared, produced only 30.4 and 48 bushels of decayed tubers per acre.

In conclusion we give in tabular form the results of experiments at this Station for fourteen successive years, including for the current year the average of the results from the three fields.

GAINS FROM USE OF BORDEAUX MIXTURE ON LATE POTATOES

Variety	Planted	Sprayed	Yield per acre		Gain per acre
			Where sprayed	Whe'e not sprayed	
White Star...	May 11, 1891.	Aug. 26, Sept. 8.........	313 bu.	248 bu.	65 bu.
" " ...	May 20, 1892.	July 30, Aug. 13, 25......	291 bu.	99 bu.	192 bu.
" " ...	May 20, 1893.	Aug. 1, 16, 29............	338 bu.	114 bu.	224 bu.
" " ...	Apr. 26, 1894.	Jnne 16, July 17, Aug. 30	328 bu.	251 bu.	77 bu.
" " ...	May 20, 1895.	July 25, Aug. 13, 31.....	389 bu.	219 bu.	170 bu.
Polaris.........	May 15, 1896.	Aug. 7, 21	325 bu.	257 bu.	68 bu.
"	June 1, 1897.	July 27, Aug. 17, 28.....	151 bu.	80 bu.	71 bu.
White Star....	May 10, 1898.	July 21, Aug. 10.........	238 bu.	112 bu.	126 bu.
Average 3 var.	May 18, 1899.	July 26, Aug. 17, Sept. 8	229 bu.	161 bu.	68 bu.
Delaware	May 23, 1900.	Aug. 4, 23................	285 bu.	225 bu.	60 bu.
"	May 25, 1901.	July 20, Aug. 21.........	170 bu.	54 bu.	116 bu.
"	May 15, 1902.	Aug. 1, 20................	298 bu.	164 bu.	134 bu.
Green Mount.	May 1, 1908.	Aug. 10...................	361 bu.	237 bu.	124 bu.
Delaware......	May 25, 1904.	About Aug. 1 & Sept. 1	327 bu.	193 bu.	134 bu.
Average for fourteen years..................			289 bu.	173 bu.	116 bu.

II. RELATION OF DATE OF DIGGING TO DEVELOPMENT OF ROT.

When potato tops are blighting, is it better to dig at once or not? This is a practical question often asked and the lack of scientific information and of uniformity in practice alike show the need of its investigation. Trials were made and reported upon in 1902 and 1903,[1] and those of 1904 were in continuation thereof.

The soil conditions and planting were as follows: Grass land, good sandy loam, well drained, with liberal application of stable manure; potatoes planted May 28; varieties, Green Mountain, Delaware, Rural New Yorker No. 2, Polaris, Early Rose, Early Ohio. Ten rows were planted to each variety, 3 feet apart and 91 feet long, i. e. one square rod per row. The seed was not uniformly good, especially the Early Rose and Green Mountain, so that the relative yields of the different varieties have little significance. A single application of paris green was made early in July, but otherwise no spraying was done. Two rows of each plot were dug on each date, August 22 and 29, September 5 and 12, and one row of each on September 19 and 26.[2]

The condition of foliage as noted by the field observer was as given below. The appearance of the rot in the tubers from the earlier diggings justifies the conclusion that the late blight fungus was actually present in small amount on the foliage at an earlier date than is here recorded. The notes are however here reported as they were made in the field. The accompanying weather conditions were discussed earlier in this report.

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[1] Vt. Sta. Rpt. 15, p. 219 (1902); 16, p. 161 (1903). See also Soc. Prom. Agl. Sci. Proceedings 25, p. 91 (1904).

[2] The yields from the rows dug Sept. 19 and 26 as shown in the table, have been multiplied by two so as to make them comparable to the other plots.

Green Mountain.—August 22, plants in healthy condition, no blight, mostly past blossom. August 29, green and healthy. September 5, foliage mostly green, little early blight. September 12, one-fourth of the leaves dead from early blight, late blight doubtful. September 19, three-fourths of the foliage dead, chiefly from early blight. September 23, killed by frost.

Delaware.—August 22, good condition; tops covering the ground, just past blossoming period, no blight. August 29, green and healthy. September 5, fairly healthy, some early blight. September 12, one-fourth of leaves dead from early blight with a few questionable cases of late blight. September 19, foliage entirely dead.

Rural New Yorker No. 2.—August 22, green and healthy, just past flowering stage. August 29, green and healthy. September 5, quite healthy, some early blight, and possibly a little late blight. September 12, three-fourths dead from early blight with a little mixture of late blight. September 19, foilage entirely dead, largely from early blight, but some late blight.

Polaris.—August 22, just in flower, leaves nearly half dead with early blight and tip burn. August 29, foliage two-thirds dead with early blight. September 5, leaves entirely dead, chiefly from early blight. September 12, tops entirely dead.

Early Rose.—August 22, green and healthy. September 5, still green, but considerable early blight. September 12, one-half of leaves dead from early blight, some indications of late blight. September 19, tops entirely dead.

Early Ohio.—August 22, yellow and dying. August 29, dying rapidly. September 5, nearly dead. September 12, all dead.

As soon as dug the potatoes were stored in a cool cellar in bushel boxes, stacked in such a way as to allow free circulation of air. The temperature of the storage cellar stood at 50 to 55° F., except during the early part of the period, when it occasionally reached 60° F. This occurred but seldom and for short periods. It probably did not rise above that figure.

Each lot was carefully sorted when dug and the weights of sound and decayed tubers recorded. On each date of digging all tubers previously dug and in storage were sorted, and the decayed ones weighed and removed. The entire lot was again sorted on November 5, nearly six weeks after the first digging. The data thus secured is entered in the following table:

Variety	Date of digging	Total weight	Pounds decayed August 22	Pounds decayed August 29	Pounds decayed September 5	Pounds decayed September 12	Pounds decayed September 19	Pounds decayed September 26	Pounds decayed November 5	Total pounds decayed to November 5	Total pounds sound to November 5	Percent of decay on November 5
G. Mt.	Aug. 22	17.5	0	2	2	0	0	0.5	0.6	5.1	12.4	...
Del. •	“	76.	0	6.3	2.3	1	1	0	0	8.5	67.5	...
R. N. Y.	“	120.	0	0	0	0	0	0	1.0	1.	119.	...
Polaris,	“	135.	0	0	0	0	0	0	3.5	3.5	131.5	...
E. Rose,	“	29.	0	0	0	0	0	0	0	0	29.	...
E. Ohio,	“	44.	0	0	0	0	0	0	0	0	44.	...
		421.5								18.1	403.4	4.3
G. Mt.	Aug. 29	27.5	..	0	3.5	6.5	0	0	0	10.	17.5	...
Del.	“	98.	..	0	12.0	2.0	0	0	1.5	15.5	82.5	...
R. N. Y.	“	158.5	..	0	7.5	5.5	0	0	0	13.	145.5	...
Polaris,	“	136.	..	0	2.0	0	0	0	8.5	10.5	125.5	...
E. Rose,	“	35.5	..	0	6.3	2.5	0	0	0.5	9.3	25.2	...
E. Ohio,	“	44.5	..	0	0	0.2	0	0	0.5	0.7	43.8	...
		500.								59.0	440.0	11.8
G. Mt.	Sept. 5	43.	..	..	0	0	0	0	2.0	2.	41.	...
Del.	“	141.	..	..	0	0	0	0.5	15.0	15.5	125.5	...
R. N. Y.	“	204.	..	..	0	0	0	0	93.0	93.	111.	...
Polaris,	“	137.	..	..	0	0	0	0	1.0	1.	136.	...
E. Rose,	“	49.	..	..	0	0	0	0	3.0	3.	46.	...
E. Ohio,	“	51.5	..	..	0	0	0	0	0.5	0.5	51.	...
		625.5								115.0	510.5	18.4
G. Mt.	Sept. 12	47.	..	..	..	0	0	0	0	0	47	...
Del.	“	153.	..	..	..	0	1	0.7	4.5	6.2	146.8	...
R. N. Y.	“	203.	..	..	..	0	4	2.5	29.0	35.5	167.5	...
Polaris,	“	156.	..	..	..	0	0	0	1.0	1.	155.	...
E. Rose,	“	51.	..	..	..	0	0	0	15.5	15.5	35.5	...
E. Ohio,	“	47.5	..	..	..	0	0	0	0	0	47.5	...
		657.5								58.2	599.3	8.9
G. Mt.	Sept. 19	53	..	..	..	..	0	0	0	0	53	...
Del.	“	148	..	..	..	..	3	2	0	5	143	...
R. N. Y.	“	200	..	..	..	..	10	14	16	40	160	...
Polaris,	“	134	..	..	..	..	0	0	2	2	132	...
E. Rose,	“	50	..	..	..	..	0	0	2	2	48	...
E. Ohio,	“	46	..	..	..	..	0	0	2	2	44	...
		631								51	578	8.0
G. Mt.	Sept. 26	44.	..	..	..	..	..	0	0	0	44.	...
Del.	“	172.	..	..	..	..	..	2	4	6	166.	..
R. N. Y.	“	184.	..	..	..	..	..	24	4	28	156.	...
Polaris,	“	167.	..	..	..	..	..	0	2	2	165.	...
E. Rose,	“	34.	..	..	..	..	..	0	1	1	33.	...
E. Ohio,	“	56.	..	..	..	..	..	0	2	2	54.	...
		657.								39	618.	6.0

DISCUSSION OF THE RESULTS

Owing to the peculiar weather conditions the progress of the late blight fungus on the foliage was at no time very conspicuous. Evidently, however, but slight infection of the tubers occurred before August 22, and there was little of practical moment after September 12. Nor was there much increase in the crop yield after this latter date.

The Early Ohio potatoes matured ahead of the fungus and there was practically no rot among them. With other varieties the rot was considerable, and the most of this occurred in the earlier dug tubers, i. e. the diggings of August 29 and September 5. The basis for this conclusion is seen clearly in the following figures drawn from the preceding tables, which give the average conditions existing on November 5 in the tubers dug at each date:

Date of digging	Aug. 22	Aug. 29	Sept. 5	Sept. 12	Sept. 19	Sept. 26
Percent of rot	4.3	11.8	18.4	8.9	8.0	6.0
Pounds sound potatoes......	403	440	510	599	578	618

It is worth while to recall in this connection the results of similar experimental diggings made last year, as follows:[1]

Date of digging	Aug. 31	Sept. 7	Sept. 14	Sept. 21	Sept. 28
Percent of rot...........	55.3	25.7	15.8	11.4	7.3
Pounds sound potatoes...	84	150	169	175	171

The disease appeared somewhat earlier in 1903 and was more severe, but the trend of the results is the same. In both seasons much the greatest loss from rot occurred from the diggings of the last week of August and the first week of September—when the tops were still in vigorous condition and the tubers immature and probably but recently infected. There was much less loss where the digging was delayed till mid-September, when the vines as a whole were nearly dead and tuber growth practically completed. Somewhat less rot resulted on the average each season where the digging was delayed until about September 20, and a little less when it was postponed still one week later.

The results obtained in 1902 prompted the formulation of a tentative rule,[2] which was repeated with more confidence at the close of the trials of 1903, viz., "where there is danger of rot it is best to delay the digging for some ten days or more after the tops die and a longer delay does no harm."

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[1] Vt. Sta. Rpt. 16, p. 162 (1903).

[2] Vt. Sta. Rpt. 15, p. 223 (1902).

The results of three successive seasons' work have shown this rule to be even safer as a generalization than was hoped when it was formulated. It may be now restated, slightly modified, as a safe rule for Vermont farm practice.

When potato tops have been killed by the late blight fungus and there is consequent danger of rot of the tubers, do not dig them until a week or more after the tops were killed. A longer delay will do no harm. With late varieties, where the progress of the disease is slow, do not begin digging until the third week of September at the earliest, and if practicable wait until after the tops are killed by frost.

III. DOES LIMING PREVENT ROT?

Results obtained last year[1] gave a negative answer to this question. It seemed best, however, to repeat the trial on a larger scale. Accordingly one-half of the yield from each variety dug on the first four dates, August 22, 29, September 5 and 12, in the experiment just discussed, was thoroughly sprinkled with air-slaked lime, about one-fourth pound being used to a bushel. These were stored under exactly the same conditions as were the unlimed tubers. The nature of the soil, sorting and condition of the foliage at each date of digging have been discussed on pages 391-392.

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[1] Vt. Sta. Rpt. 16, p. 163 (1903).

The tabulated results follow:

Date	Sound tubers	Weight of tubers found decayed												Total to Nov. 5			
		Aug. 29		Sept. 5		Sept 12		Sept 19		Sept 26		Nov. 5		Decayed		Sound	
		Limed	Untr'd	Limed	Untr'd	Limed	Untr'd	Limed	Untr'd	Limed	Untr'd	Limed	Untr'd	Limed	Untr'd	Limed	Untr'd
GREEN MOUNTAIN																	
Aug. 22.....	8.7	0.7	...	1	...	0	...	0	...	0.5	...	0.5	...	....	....	.....	.....
“ “.....	8.7	...	1.2	...	1	...	0	...	0	...	0	...	0.1	....	....	.....	.....
“ 29.....	13.7	0	...	1.5	...	3	...	0	...	0	...	0	...	....	....	.....	.....
“ “.....	13.7	...	0	...	2	...	3.5	...	0	...	0	...	0	....	....	.....	.....
Sept. 5.....	21.5	...	...	0	...	0	...	0	...	0	...	1	...	....	....	.....	.....
“ “.....	21.5	...	...	...	0	...	0	...	0	...	0	...	1	....	....	.....	.....
“ 12.....	23.5	...	...	...	...	0	...	0	...	0	...	0	...	....	....	.....	.....
“ “.....	23.5	...	...	...	...	...	0	...	0	...	0	...	0	8.2	8.8	59.2	58.6
DELAWARE																	
Aug. 22.....	88.	2.7	...	0.7	....	0.4	...	0.5	...	0	...	0	...	....	....	.....	.....
“ “.....	88.	...	3.5	...	1.5	...	0.6	...	0.5	...	0	...	0	....	....	.....	.....
“ 29.....	49.	0	...	1.5	....	0.5	...	0	...	0	...	1	...	....	....	.....	.....
“ “.....	49.	...	0	...	10.5	...	1.5	...	0	...	0	...	0.5	....	....	.....	.....
Sept. 5.....	70.5	...	...	0	....	0	...	0	...	0	...	5	...	....	....	.....	.....
“ “.....	70.5	...	...	...	0	...	0	...	0	...	0.5	...	10	....	....	.....	.....
“ 12.....	76.5	...	...	...	....	0	...	0	...	0	...	1.5	...	....	....	.....	.....
“ “.....	76.5	...	...	...	....	...	0	...	1	...	0.7	...	3	13.9	33.8	220.1	200.2
RURAL NEW YORKER NO. 2																	
Aug. 22.....	60.	0	...	0	...	0	...	0	...	0	...	0.5	...	....	....	.....	.....
“ “.....	60.	...	0	...	0	...	0	...	0	...	0	...	0.5	....	....	.....	.....
Aug. 29.....	79.2	0	...	3	...	3	...	0	...	0	...	0	...	....	....	.....	.....
“ “.....	79.2	...	0	...	4.5	...	2.5	...	0	...	0	...	0	....	....	.....	.....
Sept. 5.....	102.	...	...	0	...	0	...	0	...	0	...	50	...	....	....	.....	.....
“ “.....	102.	...	...	...	0	...	0	...	0	...	0	...	43	....	....	.....	.....
“ 12.....	101.5	...	...	...	...	0	...	2	...	0	...	18	...	....	....	.....	.....
“ “.....	101.5	...	...	...	...	...	0	...	2	...	2.5	...	11	76.5	66	266.2	276.7
POLARIS																	
Aug. 22.....	62.5	0	...	0	...	0	...	0	...	0	...	1	...	....	....	.....	.....
“ “.....	62.5	...	0	...	0	...	0	...	0	...	0	...	2.5	....	....	.....	.....
“ 29.....	68.	0	...	2	...	0	...	0	...	0	...	5.5	...	....	....	.....	.....
“ “.....	68.	...	0	...	0	...	0	...	0	...	0	...	3	....	....	.....	.....
Sept. 5.....	68.5	...	...	0	...	0	...	0	...	0	...	0.5	...	....	....	.....	.....
“ “.....	68.5	...	...	...	0	...	0	...	0	...	0	...	0.5	....	....	.....	.....
“ 12.....	78.	...	...	...	...	0	...	0	...	0	...	0	...	....	....	.....	.....
“ “.....	78.	...	...	...	...	...	0	...	0	...	0	...	1	9.0	7.0	273.0	275.0
EARLY ROSE																	
Aug. 22.....	14.5	0	...	0	...	0	...	0	...	0	...	0	...	....	....	.....	.....
“ “.....	14.5	...	0	...	0	...	0	...	0	...	0	...	0	....	....	.....	.....
“ 29.....	17.7	0	...	1.7	...	1	...	0	...	0	...	0	...	....	....	.....	.....
“ “.....	17.7	...	0	...	4.5	...	1.5	...	0	...	0	...	0.5	....	....	.....	.....
Sept. 5.....	24.5	...	...	0	...	0	...	0	...	0	...	0	...	....	....	.....	.....
“ “.....	24.5	...	...	...	0	...	0	...	0	...	0	...	3	....	....	.....	.....
“ 12.....	25.5	...	...	...	...	0	...	0	...	0	...	8	...	....	....	.....	.....
“ “.....	25.5	...	...	...	...	...	0	...	0	...	0	...	7.5	10.7	17.0	71.5	65.2
EARLY OHIO																	
Aug. 22.....	22.	0	...	0	...	0	...	0	...	0	...	0	...	....	....	.....	.....
“ “.....	22.	...	0	...	0	...	0	...	0	...	0	...	0	....	....	.....	.....
“ 29.....	22.2	0	...	0	...	0	...	0	...	0	...	0	...	....	....	.....	.....
“ “.....	22.2	...	0	...	0	...	0.2	...	0	...	0	...	0.5	....	....	.....	.....
Sept. 5.....	25.7	...	...	0	...	0	...	0	...	0	...	0	...	....	....	.....	.....
“ “.....	25.7	...	...	...	0	...	0	...	0	...	0	...	0.5	....	....	.....	.....
“ 12.....	23.7	...	...	...	...	0	...	0	...	0	...	0	...	....	....	.....	.....
“ “.....	23.7	...	...	...	...	...	0	...	0	...	0	...	0	0	1.2	93.7	92.5

The results may be summarized as follows:

Variety		Limed	Unlimed	Gain or loss
Green Mountain......	total decay...	12 percent	13 percent	+1 percent
Delaware.............	" " ...	6 "	14 "	+8 "
Rural New Yorker...	" " ...	22 "	19 "	−3 "
Polaris................	" " ...	3 "	2 "	−1 "
Early Rose...........	" " ...	13 "	20 "	+7 "
Early Ohio...........	" " ...	0 "	1 "	+1 "
Averages..........	" " ...	9 "	11 "	+2 "

There was therefore a slight gain on the average from the use of lime. These results may well be compared with those obtained last year, when there was slightly more rot in the limed potatoes, viz., 29 percent in those limed as compared with 27 percent in the unlimed. This year four out of the six showed rot where limed, last year three out of four showed less rot where not limed. These differences, taking the average of the two seasons, exactly neutralize each other. The results of the two years' trials therefore lead us to doubt the practical value of liming potatoes.[1]

IV. DISINFECTION OF SCABBY POTATOES BY FORMALDEHYDE GAS

Soaking seed potatoes in either corrosive sublimate or formalin solution is the standard method of disinfection and is commended for ordinary farm practice. It is, however, a laborious process for the large grower and seed dealer who handles large quantities of seed in storage bins. Hence trials were begun some years ago[2] in which large quantities of seed were treated with the fumes of gaseous disinfectants. Sulphur fumes were tested and proved valueless, but formaldehyde (formalin) gas promised so well that its trial has been continued through several seasons and its efficacy apparently demonstrated.

The trials made in 1904 were located on land adjoining that hitherto used for similar experiments, being recently cleared pine land not previously sown to cultivated crops. New land has been broken up each year which, no doubt, is entirely free from contamination.

The seed was selected from crops grown on the scab plots of 1903, two varieties, Delaware and Rural New Yorker No. 2 being used.

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[1] The Market Growers' Gazette (London), Dec. 14, 1904. p. 427, after the above was written, published results of two years' trials of liming, made under the direction of H. Hunter, of the Department of Agriculture of Ireland. So far as can be gathered from the brief summary there given the results in general showed no benefit from liming. The only exception was in one lot where a large amount of potatoes showing soft rot were mixed with the sound ones at the beginning of the experiment. In this case the use of lime checked the spread of the rot.

[2] Vt. Sta. Rpts. 13, p. 273 (1900); 14, p. 231 (1901); 15, p. 227-230 (1902); 16, p. 165 (1903).

In each case the seed was divided into two classes, "smooth" and "scabby," as has been done in previous trials. The latter were badly scabbed tubers, while the former showed no visible signs of the disease, though sorted from the same lots as the scabby seed. Doubtless both lots carried the germs of the scab on the surface, although the results show that the disease developed much worse from the scabby seed.

This seed was planted in eight plots as described below, each plot comprising four rows 75 feet long and requiring one-half bushel of seed. The experimental plots were separated in each case by non-experimental check rows of another variety which had previously been disinfected with formalin solution.

Four methods of disinfection were compared as follows:

First—Seed soaked two hours in a solution of 8 ounces formalin in 15 gallons water; standard method; used as a basis of comparison (Plot I).

Second—Formalin vapor; seed dry and uncleaned, i. e. just as they came from the bin; 25 c. c. formalin (Plot II); 12.5 c. c. (Plot V).

Third—Formalin vapor; seed soaked one-half hour in water before treatment and placed in disinfecting box while wet; 25 c. c. formalin (Plot III); 12.5 c. c. (Plot VI).

Fourth—Formalin vapor; seed thoroughly washed in water and allowed to dry before placed in disinfecting box; 25 c. c. formalin (Plot IV); 12.5 c. c. (Plot VII).

The seed planted on Plot VIII was left untreated.

Merck's formalin (40 percent formaldehyde) was used in all cases. The potatoes to be treated with formalin vapor (30 pounds in each lot) were enclosed in a box containing 8.2 cubic feet, capable of being tightly closed. The method of vaporizing the formalin was somewhat modified from that heretofore used.[1] The desired amount of formalin (either 12.5 or 25 c. c.) was diluted with 100 c. c. of water, then placed in a flask, connected with the disinfecting box by a tube and distilled slowly, the vaporized water being continuously replenished, so that at the end of an hour one-half the volume still remained. This was then boiled to about one-tenth the original volume, which served to vaporize practically all the formalin. A thermometer in the box showed that the temperature remained below 80° F. during this process. After its close the box was left shut for 24 hours. When opened at the end of this period a strong odor of formalin was evident. All disinfecting was performed within twenty-four to forty-eight hours before planting, and the seed after disinfection was placed in new, clean paper sacks.

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[1] The details of the method here employed were suggested by the Station chemist. Those hitherto used—boiling in closed glass flask (1900) and in a coil of gaspipe (1903) were open to serious objection of breakage and loss through chemical changes caused by high temperatures operating in closed receptacles. Accordingly the method of generating the vapor was modified as follows: The required amount of formalin solution was diluted to 100 c. c., placed in a rubber stoppered flask, tubes being fitted therein, one opening just belo wthe cork and connected by rubber tubing with the disinfecting box, the other extending to the bottom of the flask and opening below the surface of the fluid, and connected by rubber tubing with a steam generator. As soon as the diluted formalin reached boiling a stream current was turned on from the generator. A thermometer inserted in the top of the box enabled one to avoid overheating with the steam current, which was also guarded against by the use of a long conveying tube. The steam and the flame under the flask were so regulated that the liquid was kept at any desired level. This procedure was carried on for one hour. While the current of steam was passing through the liquid all of the time it was so regulated that the volume of the liquid was reduced one-half and then restored to original volume by condensation of the flowing steam several times. At the close of the hour the steam was cut off and the contents of the flask slowly boiled down to 10 or 15 cubic centimeters.

The disinfections were made on May 10 and 11, and, on May 12, the potatoes were planted, commercial fertilizer being used. The plants were unsprayed save with paris green. Potatoes grown on the sandy soils near Burlington are particularly susceptible to early blight, and this disease killed the tops upon these scab plots before the first of September. The tubers were left undug, however, until frost threatened in order to give the scab the fullest opportunity to develop. They were dug on October 28 and were sorted as soon thereafter as possible.

The detailed results are given in the accompanying table:[1]

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[1] On account of lack of scabby seed of Rural New Yorker No. 2, smooth Delaware and Rural New Yorker No. 2 seed, disinfected with formalin solution, was placed in the last row of each of plots V-VII; consequently only the data afforded by smooth and scabby Delaware rows are considered in the summary for these plots.

Plot and variety	Condition of seed	Treatment	Total weight of tubers	Smooth		Scabby		
				Weight	Number	Weight	Number	Percent (by number)
			lbs.	lbs.	lbs.	lbs.	lbs.	
PLOT I								
Delaware,	Scabby	Formalin Sol.	35.	33.3	387	1.7	13	3.3
"	Smooth	" "	58.2	57.9	387	0.3	3	0.8
R. N. Y. 2	Smooth	" "	60.	59.2	465	0.8	5	1.1
"	Scabby	" "	50.	47.6	420	2.4	19	4.3
PLOT II								
Delaware,	Scabby	For. vapor 25 cc seed dry	54.	53.9	475	0.1	1	0.2
"	Smooth	" "	60.	59.4	534	0.6	6	1.1
R. N. Y. 2	Smooth	" "	61.	60.7	430	0.3	2	0.5
"	Scabby	" "	47.	47.0	361	0.0	0	0
PLOT III								
Delaware,	Scabby	For. vapor 25 cc seed wet	49.	48.4	412	0.6	6	1.4
"	Smooth	" "	43.	43.	359	0.0	0	0
R. N. Y. 2	Smooth	" "	50.8	50.6	347	0.2	2	0.6
"	Scabby	" "	49.0	48.3	312	0.7	8	2.5
PLOT IV								
Delaware,	Scabby	For. vapor 25 cc seed scrubbed	42.8	41.9	367	0.9	4	1.1
"	Smooth	" "	42.0	42.0	328	0.0	0	0
R. N. Y. 2	Smooth	" "	45.5	45.1	316	0.4	3	0.9
"	Scabby	" "	31.5	31.0	251	0.5	3	1.2
PLOT V								
Delaware,	Scabby	For. vapor 12½ cc seed dry	48.	47.4	402	0.6	9	2.2
"	Smooth	" "	45.	43.5	440	1.5	15	3.3
R. N. Y. 2	Smooth	" "	64.	63.9	499	0.1	1	0.2
Delaware.	Smooth	Formalin sol.	61.	60.9	437	0.1	1	0.2
PLOT VI								
Delaware,	Scabby	For. vapor 12½ cc seed wet	36.	34.2	331	1.8	12	3.5
"	Smooth	" "	37.	35.5	375	1.5	12	3.1
R. N. Y. 2	Smooth	" "	54.	52.1	442	1.9	17	3.7
"	Smooth	Formalin sol.	40.	39.0	377	1.0	7	1.8
PLOT VII								
Delaware,	Scabby	For. vapor 12½ cc seed scrubbed	46.	44.5	477	1.5	18	3.6
"	Smooth	" "	56.	56.0	523	0.0	0	0
R. N. Y. 2	Smooth	" "	67.	66.5	537	0.5	2	0.4
Delaware,	Smooth	Formalin sol.	47.8	47.3	558	0.5	6	1.1
PLOT VIII								
Delaware,	Scabby	Untreated	41.8	31.8	333	10.0	101	23.3
"	Smooth	"	58.5	57.7	556	0.8	4	0.7
R. N. Y. 2	Smooth	"	65.	64.8	637	0.2	4	0.6
"	Scabby	"	59.6	46.9	385	12.7	95	19.8

The most significant data which the last table presents are more easily compared when reduced to the following form. They show the percentages (by number, not weight) of scabby tubers resulting from the various treatments;

Character of seed	Not disinfected	Formalin solution	25 c. c. formalin vaporized			12½ c. c. formalin vaporized		
			Seed dry	Seed scrubbed	Seed wet	Seed dry	Seed scrubbed	Seed wet
Delaware								
Scabby seed	23.3	3.3	0.2	1.1	1.4	2.2	3.6	3.5
Smooth seed	0.7	0.8	1.1	0.0	0.0	3.3	0.0	3.1
Rural New Yorker								
Scabby seed	19.8	4.3	0.0	1.2	2.5	...	...	...
Smooth seed	0.6	1.1	0.5	0.9	0.6	...	...	...
Averages from								
Smooth seed	0.7	1.0	0.8	0.5	0.3	3.3	0.	3.1
Scabby seed	21.6	3.8	0.1	1.1	2.0	2.2	3.6	3.5

DISCUSSION OF THE RESULTS

As in all previous trials, minor irregularities occur. These may, of course, be due to accidental infection in the field; in any case they prevent exact comparisons or conclusions. Nevertheless the evidence is unmistakable as to the general outcome. Clearly the results from the smooth seed are to be disregarded since there is but little scab anywhere, and no more in the rows where no disinfection was practiced than on the average in the treated rows. There can be no question, however, as to the reduction of disease by disinfection where scabby seed was used. It is likewise evident that the gaseous treatment is fully as effective as the standard method of soaking in formalin solution. Moreover, the conclusion seems inevitable that the gaseous treatment was *more effective on the dry seed* than upon that which was wet. This feature in the outcome was not what we expected, but we are forced to accept it since the results are in full accord with those obtained in the trials made in 1903,[1] reproduced here for convenience of comparison.

		Not disinfected	Formalin solution	Formalin vapor seed dry	Formalin vapor seed wet
Delaware..........	Scabby	24.2	2.2	2.4	15.0
"	Smooth	3.1	0.2	0.2	7.1
Rural New Yorker..	Scabby	24.5	1.0	1.5	8.5
"	Smooth	4.1	0.9	0.2	2.3

The logical inference seems to be that the layer of moisture upon the surface of the tubers does not readily absorb the formalin gas; hence the latter is prevented from full action upon the germs. As already explained, the distillation method used this year is an improvement over that previously used, to which may be attributed the greater effectiveness of the 1904 treatment, especially on the wet seed.

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[1] Vt. Sta. Rpt. 16, p. 167 (1903).

The outcome of the present trials, so far as it goes, indicates better results from the distillation of the larger amount of formalin, although the results from the smaller amount seem fully equal to those from soaking in the formalin solution. In the light of these trials we suggest the use of larger quantities than heretofore advised, viz., three pounds (three pints) of formalin for each 1,000 cubic feet of storage room to be disinfected. This should be diluted before distillation with not less than four times its volume of water, and it would probably be better to use twice this amount. The disinfecting chamber should be made as tight as possible, the smaller and the tighter the better. Place the formalin solution in one or more kettles or pans over a kerosene or other stove in the middle of the room, supplied with fuel enough to evaporate the water nearly or quite fully; retire from the room, close it tightly and leave it closed for twenty-four hours or longer.[1]

AN INSPECTION OF GRASS AND CLOVER SEED.

Vermont is pre-eminently a grass growing State. Its farmers pay more money for grass and clover seeds than for all other kinds. Formerly these were grown in New England; now they are mostly supplied from Chicago and other more Western markets. Eastern farmers have come to believe that in many cases the quality of this seed is inferior and to attribute failure to secure a stand or weediness of the newly seeded fields to such inferiority. To add to the information on this point this Station has at one time and another[2] published the results of such examinations as it has made into the conditions of the seed trade of Vermont. During the past year a much more painstaking investigation was undertaken in response to a request expressed in a joint resolution of the General Assembly of 1902, reading as follows:

Resolved by the Senate and House of Representatives:

That the Vermont Agricultural Experiment Station be and hereby is requested to study the condition of the trade in this State in grass and other agricultural seeds with a view of recommending to the next

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[1] Just as this matter is going to press a more convenient method of generating formaldehyde gas which may prove equally effective is brought to our attention. Evans & Russell (Bul. Maine Lab. of Hygiene, 1904) propose that formalin be added to powdered potassium permanganate in the proportion of a pint to 6.5 ounces. They state that 69 percent of the gas is made available in five minutes and that an 81 percent yield is eventually obtained. This method of formalin gas generation will be tested during the coming season as to its adaptation in tuber disinfection.

[2] Vt. Sta. Rpt. 13, p. 287 (1900).

General Assembly some measure looking towards the attainment of a purer seed supply.

JOHN H. MERRIFIELD,
Speaker of the House of Representatives.
ZED S. STANTON,
President of the Senate.

Approved November 20, 1902.
JOHN G. MCCULLOUGH, Governor.

In compliance with this resolution the Station undertook to secure samples representative of the grass and clover seeds offered in the Vermont markets in the spring of 1903. Samples representing 735 lots of seeds were obtained of dealers in all parts of the State, including:

	Samples.		Samples.
Timothy	222	Red clover (mammoth)	30
Red-top	83	Alsike clover	105
Kentucky blue grass	8	White clover	14
Orchard grass	11	Crimson clover	4
Meadow fescue	1	Alfalfa	10
Hungarian and various millets	103	Rape	1
Red clover (common)	134	Lawn grass mixtures	9
			735

These seeds were examined with results as outlined herewith and a report was filed with the General Assembly of 1904 early in November. The sampling agents were the men primarily employed in collecting samples of commercial fertilizers, and were instructed to secure representative samples of as many of the lots of grass and clover seed offered for sale as were obtainable. They were further instructed to state to dealers the object in view, to buy and pay for the seed obtained, to discover the source of the seed whenever practicable and its price per pound, to assure the local dealers that no use would be made of their names in publication when inferior seed was discovered, to use due care to make the samples thoroughly representative of the lots and to ship them promptly to the Station in sealed envelope packages.

Inasmuch as this Station did not have the facilities for handling so large a number of seed samples expeditiously, advantage was taken of a generous offer from the Seed Laboratory of the Bureau of Plant Industry, United States Department of Agriculture, to carry on the work in co-operation. It was agreed that the Station should secure the samples and information concerning them, that the Department should make the examinations of seeds as to purity and germination,

and that both institutions should be free to publish the results. The bulk of the exacting work fell upon the department officials, to whom our thanks are due. The Station is particularly indebted to Mr. Edgar Brown, botanist in charge of the Seed Laboratory, for the tabulated results with comments, which form the basis of this discussion.

Since this investigation constitutes one of the most exhaustive systematic examinations ever made into the grass seed conditions of any State, the results are printed in detail as a matter of record. These tabulated details, given in the appendix, are worthy of careful examination by any one especially interested in such matters. The more important facts and conclusions are brought together under the following heads:

RED CLOVER (common red or medium. *Trifolium pratense*)

The standards of purity and germination as recommended for first class seed by the U. S. Department of Agriculture are: Purity, 98 percent; germination, 85-90 percent.[1]

One hundred and thirty-four samples of this seed were secured. Their average purity proved to be 91 percent, and average germination, 87 percent. They ranged much below the United States standard in purity, but just about met it in germination. Examinations of the tables show that only twelve samples, or 9 percent of the whole, met the standard as to purity, whereas 122 or 91 percent were below it. With reference to germination 102 samples, or 76 percent, were up to standard, and the balance, 32 samples or 24 percent, were below.

The condition of these seeds as to purity is, therefore, decidedly unsatisfactory. A considerable number carried from 5 to 15 percent of foreign seeds. In many cases this was largely timothy, but in some samples there was a large amount of weed seeds. The worst indictment is that one sample, No. 19,016, shows evident adulteration, since it contains 49 percent of foreign seed, principally yellow trefoil.[2]

The Department states that this a common adulterant of red clover and alfalfa seed. Other cases of its use will be cited under

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[1] "The term *purity*, the percentage of which is reckoned by weight, denotes freedom from foreign matter such as chaff, dirt or seeds of other plants. The percentage of *germination* is reckoned by count from a sample freed from foreign matter, a seed being counted germinated when the rootlet or radicle has pushed through the seed coat."—U. S. Dept. Agr. Year-book of 1896, p. 623.
The above "standards" have no legal status but simply form an expression of expert opinion as to what should be the condition of good commercial seed.
The germination tests reported upon here were based upon trials conducted by the standard methods of the Department.

[2] Yellow trefoil, also called black medic (*Medicago lupulina*) is an annual plant of the clover family with low spreading stems and small yellow cloverlike blossom. It is not an objectionable plant in meadow or pasture, except in so far as it occupies the place of better clovers.

mammoth clover and alfalfa. Yellow trefoil seed is imported from Europe, principally for purposes of adulteration. It is significant in this connection that the three samples showing such adulteration all came from one retailer, who stated to our sampling agent that they were purchased by him from a wholesale house in New York, a firm which, according to advice from the Department, is a large importer of yellow trefoil and for many years has used it as an adulterant. Attention will be directed later to the attempt in Kentucky to legislate directly against such adulteration.

The germination tests gave better results on the whole. It should be noted, however, that several showed so low germination as to justify the conclusion that they were old seed. One sample, No. 18,748, was practically lifeless, showing less than 1 percent germination. A dealer who knowingly sells old, dead clover seed deserves censure. Clover seed, if kept beyond one year, even under good conditions, is liable to lose somewhat in vitality. Old seed should never be used or offered for sale without carefully testing it beforehand.

MAMMOTH RED CLOVER. (*Trifolium pratense var.*)

United States standards.—Purity, 98 percent; germination, 85-90 percent.

Averages found in 50 samples examined.—Purity, 90 percent; germination, 85 percent.

Percent of samples meeting U. S. standards of purity	2
Percent of samples below U. S. standards of purity	98
Percent of samples meeting U. S. standards of germination	88
Percent of samples below U. S. standards of germination	12

On the face of the returns the mammoth clover seed appears rather poorer than does the common red. As a matter of fact, however, the impurities were mostly alsike and timothy seed mixed with a comparatively small amount of weed seeds. The presence of the alsike indicates that the seed is of Canadian origin. One sample, No. 19,000, contained about 46 percent of foreign seed, principally yellow trefoil, evidently added as an adulterant. This came from the same source as red clover No. 19,018, and the comments already made regarding that sample apply to this as well.

An important fact not shown in such examinations as are here reported is that much of the clover seed offered on the markets as "Mammoth" is really the common red variety. The Rhode Island Station[1] found that of eight samples secured from as many leading seed houses only four were true to name. This shows a surprising condition, when it is remembered that both varieties are American grown and that the two are offered at practically the same price.

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[1] R. I. Sta. Rpt. 17, p. 202 (1904).

ALSIKE CLOVER. (*Trifolium hybridum.*)

United States standards.—Purity, 95 percent; germination, 75-80 percent.

Averages found in 105 samples examined.—Purity, 85 percent; germination, 77 percent.

Percent of samples meeting U. S. standards of purity	10
Percent of samples below U. S. standards of purity	90
Percent of samples meeting U. S. standards of germination	73
Percent of samples below U. S. standards of germination	27

Here, again, the figures look somewhat worse than were the actual conditions. A number of the samples contain 10 percent or more of foreign seeds. In most cases this is largely timothy seed mixed with a smaller percent of weed seeds. A few samples contain some white clover seed. The bulk of the foreign seeds in samples No. 19,066 and No. 19,184 is, however, sheep sorrel (*Rumex acetosella*), which we have found in all previous examinations to be of common occurrence in alsike clover seed.

WHITE CLOVER. (*Trifolium repens*)

United States standards.—Purity, 95 percent; germination, 75-80 percent.

Average conditions found in 14 samples examined.—Purity, 86 percent; germination, 59 percent.

Percent of samples meeting U. S. standard of purity	0
Percent of samples below U. S. standard of purity	100
Percent of samples meeting U. S. standards of germination	43
Percent of samples below U. S. standards of germination	57

Four of the 14 samples showed over 12 percent of foreign seeds. Although there were weed seeds among these, the bulk of the impurity cannot be so rated in any of these cases, since in one it consisted of alsike, in another of red clover, in another of timothy and in the other of rabbit's foot clover. These foreign seeds are all seriously objectionable in lawn seeding, but not for pasture. In the latter case it is to be considered, however, that the foreign seed is a cheaper one than the white clover.

CRIMSON CLOVER. (*Trifolium incarnatum*)

United States standards.—Purity, 98 percent; germination, 85-90 percent.

Averages found in 4 samples examined.—Purity, 96 percent; germination, 12 percent.

Since this clover is not a success agriculturally in Vermont, the conditions do not concern the matter in hand further than to show that more care must be exercised in order to secure good seed of the less used plants like this than of the standard ones.

ALFALFA. (*Medicago sativa*)

United States standards.—Purity, 98 percent; germination, 85-90 percent.

Averages found in 10 samples examined—Purity, 91 percent; germination, 79 percent.

Percent of samples meeting U. S. standard of purity.............. 10
Percent of samples below U. S. standard of purity.............. 90
Percent of samples meeting U. S. standards of germination........ 30
Percent of samples below U. S. standards of germination........ 70

The generally inferior character of this seed is noteworthy; but more so is the occurrence of one sample out of the ten (No. 18,981), containing nearly 14 percent of foreign seed, of which the bulk is yellow trefoil. This is doubtless an adulterant, as explained in the discussion of the similar adulteration of red clover.

TIMOTHY. (*Phleum pratense*)

United States standards.—Purity, 98 percent; germination, 85-90 percent.

Averages found in 222 samples examined.—Purity, 98 percent; germination, 88 percent.

Percent of samples meeting U. S. standard of purity.............. 68
Percent of samples below U. S. standard of purity.............. 32
Percent of samples meeting U. S. standard of germination........ 77
Percent of samples below U. S. standard of germination........ 23

These results show the cleanest and best seed of any kind examined and do not call for special comment. As a rule those Vermont farmers who buy high grade goods have little reason for fault-finding with the quality of timothy seed.

RED TOP. (*Agrostis alba*)

The lack of uniformity in methods of cleaning and handling this seed has deterred the seed experts of the Department from fixing upon standards. The examination of the 83 samples secured show averages as follows: Purity, 80 percent; germination, 87 percent. This reveals a fairly satisfactory condition when one considers that much of the impurity is harmless. Nevertheless, there would be a decided gain could every purchaser understand clearly the difference between the chaffy seed and the recleaned seeds of this grass, i. e. have more definite assurance as to when he is buying chaff and when seed.

The chaffy scales cling to red-top seed more closely than to timothy, and, as a result, red-top was formerly sold "in the chaff," that is, with chaff still clinging to or mixed with the seed; and it was difficult to judge from appearance how much good seed a sample contained. Methods have been perfected of late for cleaning the looser chaff from the seed in a very satisfactory manner, and all seedsmen can and should offer this "recleaned" seed. In general, one pound of such seed contains as much seed as does four pounds "in the chaff"; and the price is accordingly four times as high. No one should hesitate, however, to buy the recleaned seed at the higher price and to use a proportionately smaller quantity in seeding. The only difficulty is in being sure that one secures a high grade recleaned seed when he pays for it.

KENTUCKY BLUE GRASS. (*Poa pratensis*)

United States standards.—Purity, 90 percent; germination, 45-50 percent.

Averages found in 8 samples examined.—Purity, 63 percent; germination, 55 percent.

This showing leaves much to be desired as to purity. It is to be noted, however, that except in two cases the impurity was inert matter (chaff, etc.), some of which must be tolerated in all cases except the cleanest of such "chaffy seeds" as this. The other two cases deserve especial notice (Nos. 18,842 and 18,908). In both, the bulk of the seed is that of the Canadian blue grass (*Poa compressa*). Canadian blue grass seed is said to be the common adulterant of Kentucky blue grass, the price usually being about one-half of the latter. During the twelve months ending June 30, 1904, three-quarters of a million pounds of this seed was imported into the United States from Canada, practically all for the purpose of adulterating Kentucky blue grass seed. This state of affairs has led to the passage in Kentucky of a special law against this adulteration. (See page 415).

ORCHARD GRASS. (*Dactylis glomerata*)

United States standards.—Purity, 90 percent; germination, not yet fixed.

Averages found in 11 samples examined.—Purity, 55 percent; germination, 56 percent.

None of the samples reached the U. S. standard of purity. Here again it is to be noted that we are dealing with a chaffy seed and that the bulk of the impurity is inert matter (chaff, etc). Over one-half of the samples contain a large percent (13 to 26%) of foreign seed, which, however, is mostly that of meadow fescue. This is a good grass, but the seed costs only about one-half the price of orchard grass, and so closely resembles it that it is commonly used as an adulterant. Undoubtedly that is the case here. These adulterations are practiced by the wholesaler rather than the retailer, as is evidenced by the fact that one-half of these adulterated seeds (Nos. 18,266, 18,967, 19,055) came from one wholesale firm and the balance (Nos. 19,127, 19,233, 19,334) from another wholesaler.

The averages obtained with other seeds appear below without further comment:

RAPE. (*Brassica napus*)

U. S. standards.—Purity, 99 percent; germination, 90-95 percent.

Found in one Vermont sample.—Purity, 94 percent; germination, 98.5 percent.

MEADOW FESCUE. (*Festuca pratensis*)

U. S. standards.—Purity, 95 percent; germination, 85-90 percent.

Found in one Vermont sample.—Purity, 92 percent; germination, 46 percent.

MILLETS. (Various kinds)

U. S. standards.—Purity, 99 percent; germination, 85-90 percent.

Found in 103 Vermont samples.—Purity, 96 percent; germination, 90 percent.

LAWN GRASS MIXTURES

Nine samples show their average content of pure grass and clover seeds to be 86 percent. Lawn grass mixtures are little used in Vermont. It is well that this is so, for they are sold at extra prices and are of inferior quality. To make the best lawn in this State a mixture should be made of timothy, Kentucky blue grass and white clover. In wet soil, red-top may replace the blue grass. Several of these lawn grass mixtures contained coarse grasses and clovers which form unsightly bunches in the lawn, and are as objectionable as weed seed.

DISCUSSION OF THE RESULTS

The results here presented reveal a condition as to the seed supply of the State which is far from satisfactory. The chief evils found to exist are of four classes;

First.—*A considerable amount of inert foreign matter, dirt, chaff, etc.*, in certain classes of seeds. Little occurs in the seeds most used, i. e. timothy, red and alsike clovers, but it is more abundant in the less used and "chaffy" grasses. It does no harm except lessening somewhat the value actually secured for the price paid. The intelligent buyer who will select and pay for the best class of seeds offered rarely meets this difficulty. It is, therefore, less serious than the evils of the second and third classes which follow.

Second.—*The occurrence of weed seeds.* The limitations of the present tabulation prevent the presentation of these in detail. The results of similar examinations of previous years were presented and discussed in a former report.[1] The results of the present inquiry are in general accord with our earlier ones and show the correctness of the general opinion of farmers that clover seed is a prolific source of weeds.

"Two of the clover samples [1900 inspection] contain weed seeds at the rate respectively of 19,500 and 21,200 to the pound, while eighteen of those samples showing greatest impurity average to contain 13,000 weed seeds to the pound. Of the seeds represented above, green foxtail, pigweed, red-stem plantain (*P. Rugellii*), smartweed, English plantain, sheep sorrel and curled dock are of the most common occurrence. Of these the plantain and the sheep sorrel are the most injurious to the farmer. A pound of sample No. 49 would contain over 16,000 seeds of red-stem plantain."[2]

It certainly behooves purchasers to secure only high grade clover seed as free from weed seeds as is obtainable. On the other hand it should be borne in mind, in justice to the seed trade, that there are weed seeds enough in the average soil to give an abundant growth. Not infrequently when the soil or weather conditions are unfavorable and clover makes a poor growth it is the weed seeds from the soil that crowd it out rather than those which are introduced with the seed. Comparatively few cases have come under our observation where there were enough weed seeds in clover seeds to cause a failure to secure a fair stand. Probably the average farmer attributes a larger proportion that he should of the weeds in his newly seeded crop to foul clover seed and too small a percent to seed lying in the soil.

Third.—*The occurrence of foreign seeds of various kinds having more or less agricultural value*, and therefore, not strictly to be rated as "weeds." These should be subdivided into two classes:

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[1] Vt. Sta. Rpt. 13, p. 287 (1900).

[2] Loc. cit. p. 297.

(1.) Seeds of plants which grow commonly in mixture with the plant in question, and which must, therefore, be expected to be present in some amount in all except the purest grades of such seeds. These may in a sense be regarded as legitimate impurities, unless in too large amounts, e. g. timothy seed in mixture with alsike clover; alsike clover in mixture with red clover; timothy in mixture with redtop. The only practical objection to this class of impurities as the seeds are used in Vermont farm practice arises when the impurity is the cheaper of the two seeds. This is, therefore, a matter of minor consequence.

(2.) There is a second class of seeds, however, which are of plants not growing in natural mixture with the plants in question and whose presence is evidence of deliberate adulteration. The flagrant cases of this character were the mixtures of yellow trefoil[1] with the red clovers and alfalfa, of meadow fescue with orchard grass, of Canadian blue grass with Kentucky blue grass. These have already been commented upon under their respective heads. We will only emphasize that this constitutes, in our judgment, the strongest argument for legislation that has developed from our investigations.

Fourth.—*The low germination shown in numerous cases.* This again is of two classes:

(1.) Moderately low, such as is legitimately to be expected in the cheaper and low grades of seeds. This is a serious matter in practically all grass and clover seeds except timothy. It is, however, largely within the power of the intelligent purchaser to protect himself, so far as he chooses to do, by securing the higher grades of seeds and making germination tests as indicated below.

(2.) Very low, evidently due to the seed being old. The sample of red clover seed No. 18,748, of which only three-fourths of a percent grew, is of this class. Such cases are, however, rare, and the intelligent purchaser can protect himself by germination tests, as described later.

RECOMMENDATIONS LOOKING TO THE BETTERMENT OF CONDITIONS

It is evident from the facts set forth that there is offered in Vermont some good grass and clover seed along with much that is of an inferior grade, a little that is almost worthless and occasionally some which is adulterated. What can be done to better conditions? Two courses are open: first, more careful seed inspection; second, legislation, which may of course involve inspection also.

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[1] *Medicago lupulina,* also called black medic.

SEED INSPECTION

This Station in the past has always made careful examinations as to purity of all samples of seeds sent it and expects to continue to do so. The Seed Laboratory of the National Department of Agriculture makes similar examinations and, also, germination tests for all who ask it. Unquestionably there would be decided advantage to purchasers if they sent more samples to the Station or to the Department for examination before purchase. When this is done at least a week or ten days must be allowed for the report upon purity, and longer, of course, for that upon germination.[1]

Any painstaking person, however, can form a sufficiently accurate judgment for his practical guidance by home examination. A magnifying glass like that here figured costs but fifty cents, and with it the amount and general nature of the impurities in a sample of grass seed is readily seen. A more critical examination and some experience is, of course, necessary to identify the various weed seeds which may occur.

For making determinations as to whether or not the seed has a good degree of vitality it will suffice for most practical purposes to make home tests as follows:[2]

For testing seeds at home the simpler the method the better, providing it supplies good conditions for germination. These conditions are: temperature, about 60-70°, i. e. that of the average living room; little or no light; constant moisture but never full immersion in water. Either of the following methods serve admirably:

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[1] It frequently happens that a large number of samples are sent in only a few weeks or days before sowing time. On this account it may take a longer time than that mentioned above before the final report on all can be made. To avoid difficulties of this kind purchasers and dealers are requested to send samples as early in the season as possible.

Samples should represent the entire lot as a whole. Small quantities of not more than five bushels should be emptied on a clean floor, thoroughly mixed, and a small quantity of seed taken from different parts of the pile to make up the sample sent. When seed in a bin is to be sampled, portions should be taken from various parts, both top and bottom, mixed thoroughly, and the sample for testing taken from this lot. When seed in sacks in large quantities is to be sampled a small portion should be taken from each bag (best from different parts of the bag by means of a seed sampler) and all thoroughly mixed and the sample taken as before. At least one ounce of each kind of seed should be sent.

[2] These methods are substantially those recommended by A. J. Pieters, U. S. Dept. Agr. Year-book for 1895, p. 182.

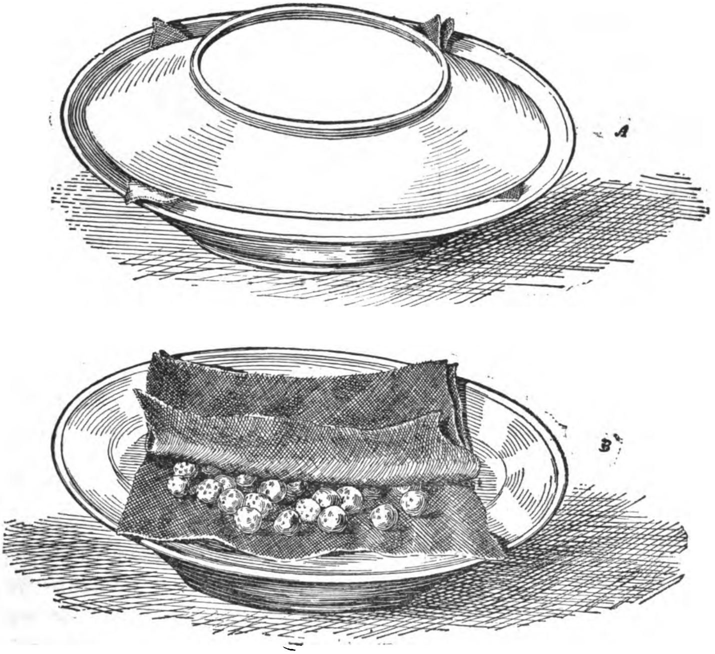

Fig. 1. Simple germinating apparatus. a, closed; b, open. (After Pieters). From U. S. Dept. Agr. Year-book, 1895.

First method.—(See figure 1.) Take two plates and place in one of them a folded cloth, preferably wool and undyed, though other cloth may do. Wet the cloth, wringing out the surplus water. Place the seeds to be tested between the moist folds and cover with the second plate so as to hold moisture and exclude light. Moisten the cloths as necessary.

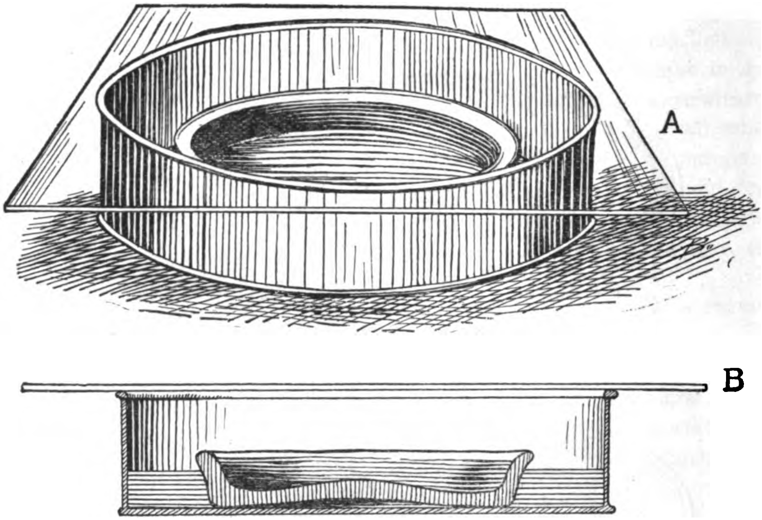

Fig. 2. Home-made germinating apparatus. a, complete; b, section. After Pieters, from U. S. Dept. Agr. Year-book (1895).

Second method.—(See figure 2.) Place a common flower pot saucer of porous clay in a larger dish, which should be agate ware, or, if tin, coated with mineral paint to prevent rusting. Add water to the outer dish to about one-half the height of the porous saucer. The water will then soak through sufficiently to keep the inner surface of the saucer favorably moist. The seeds are laid in this saucer, preferably covered in folds of cloth or blotting paper, although this is not necessary. The whole should be covered to exclude light and retain moisture.

Third method.—Soak well a handful of cotton batting in water, spread it in the bottom of a non-rusting dish, place the seeds to be tested on the cotton, add water to cover the bottom of the dish, and cover the dish to exclude light and hold moisture.

It is well to immerse the cloths and dishes in boiling water shortly before beginning the tests to kill moulds which may be clinging to them and which may otherwise cause trouble.

In making the test a definite number of seeds should be counted out, say 100, 200, or more. Under favorable conditions grass and clover seeds should begin to sprout in about three or four days. The sprouted seed should be removed each day, the number being recorded. The test should be continued ten days or somewhat longer if the conditions are unfavorable.

LEGISLATION

The joint resolution passed by the General Assembly of 1902 which led to this examination, was inspired by the hope on the part of certain members thereof that legislation might be invoked to better the conditions of the seed trade. In order to facilitate the consideration of this matter at the recent (1904) session, a compilation of the seed legislation of other states was made. For most of the data used we are indebted to Mr. Edgar Brown. A full review of these laws would be out of place here, but a summary seems pertinent. The more important state laws are those of Florida,[1] North Carolina,[2] Kentucky,[3] and Maine.[4]

A comparison of these laws shows that their chief provisions fall into three classes:

1st. Requirements that packages of seeds be stamped with the year or place of growth (North Carolina, Florida).

2nd. Forbidding specified adulterations (Kentucky).

3rd. Requirements of printed guarantee of percent of purity (Maine).

In all cases so far as information has been secured the requirements of the first class are not operative. A similar law in Vermont was a dead letter and was repealed in 1904. The conditions found to exist in Vermont hardly seem to justify legislation of the second class. The requirements of the third class promise most of value in securing improvement under the conditions existing in Vermont. We therefore append the Maine law in full:

LAWS OF MAINE, 1897, CHAPTER 313.—AN ACT TO REGULATE THE SALE OF AGRICULTURAL SEEDS

SECTION 1. Every lot of seed of agricultural plants, whether in bulk or in package, containing one pound or more, and including the seeds of cereals, except sweet corn, grasses, forage plants, vegetables and garden plants, but not including those of trees, shrubs and ornamental plants, which is sold, offered or exposed for sale for seed by any person or persons in Maine, shall be accompanied by a written or printed guarantee of its percentage of purity, freedom from foreign matter; provided, that mixtures may be sold as such when the percentages of the various constituents are stated.

SEC. 2. Dealers may base their guarantees upon tests conducted by themselves, their agents, or by the director of the Maine Agricultural Experiment Station; provided that such tests shall be made under such conditions as the said director may prescribe.

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[1] Laws of Florida, chapter 4754 (No. 13).

[2] Laws of North Carolina (Session 1890) chapter 331.

[3] Laws of Kentucky (Session 1904) chapter 82.

[4] Laws of Maine (Session 1897) chapter 313.

SEC. 3. The results of all tests of seeds made by the said director shall be published by him in the bulletins or reports of the Experiment Station, together with the names of the persons from whom the samples of seeds were obtained. The said director shall also publish equitable standards of purity, together with such other information concerning agricultural seeds as may be of public benefit.

SEC. 4. Any person or persons who shall sell, offer or expose for sale or for distribution in this State agricultural seeds without complying with the requirements of Sections 1 and 2 of this act shall, on conviction in a court of competent jurisdiction, be fined not to exceed one hundred dollars for the first offense and not to exceed two hundred dollars for each subsequent offense.

SEC. 5. Any person or persons who shall, with intention to deceive, wrongly mark or label any package or bag containing garden or vegetable seeds or any other agricultural seeds, not including those of trees, shrubs and ornamental plants, shall be guilty of a misdemeanor and upon conviction in a court of competent jurisdiction shall be fined not to exceed one hundred dollars for the first offense and not to exceed two hundred dollars for each subsequent offense.

SEC. 6. The provisions of this act shall not apply to any person or persons growing or selling cereals or any other seed for food.

SEC. 7. Whenever the director of the Maine Agricultural Experiment Station becomes cognizant of the violation of any of the provisions of the act, he shall report such violation to the secretary of the Board of Agriculture, and said secretary shall prosecute the party or parties thus reported.

SEC. 8. All acts and parts of acts inconsistent with this act are hereby repealed.

SEC. 9. This act shall take effect September 1st, 1897.

Approved March 26, 1897.

The Maine station reports that this law has proved fairly satisfactory, and that under its operation there has been an appreciable improvement in the quality of the seed sold in that State. At the same time the experience in other states indicates that there is no hope of securing a radical change in the seed supply as a result of any legislative enactment. The most important advance must come from such education of the buyers as will lead them to demand the best seed the market affords and to see that they get it. The education of the dealers themselves is also a matter of considerable importance. Indeed, the chief value of the Maine law is attributed to its educational effect upon buyers and dealers. Should the principle of this law be accepted for Vermont, it is suggested that it be restricted in its application to the agricultural grasses and clovers. As embodying this idea in its simplest form, the following section was drafted at the request of the Senate Committee on Agriculture of the last General Assembly, accompanied by a penal clause relating to unguaranteed or overguaranteed sales:

"Every lot or parcel of grass or clover seed, including millets and alfalfa, whether in bulk or in package, containing five pounds or more, which is sold, offered or exposed for sale by any person or persons in Vermont, shall have affixed thereunto in a conspicuous place on the outside thereof, a legible and plainly written or printed statement showing its percentage of purity; provided, however, that mixtures may be sold as such when the percentage of the various constituents is stated."

REPORT OF THE HORTICULTURIST

Wm. Stuart

The work of the horticultural department for the past year has been confined largely to the problems stated in the last annual report. The greenhouse investigations with tomatoes and lettuce have been so far concluded as to permit of some statement of the work done. The subjects upon which report may be made are as follows:

Some Problems in Winter Forcing of Tomatoes.
Some Studies in Indoor Lettuce Culture.
Bridge-grafting a Girdled Apple Tree.
The Preparation of Bordeaux Mixture.
Etherization as an Aid in Rhubarb Forcing.

The study of the disease resistance of potatoes to "late blight" (*Phytophthora infestans*) has been continued and greatly enlarged. Plant-breeding work has been given much more attention than last year, several hundred seedling potatoes having been grown and a considerable number of successful crosses made on some of the wild species of solanums. It is proposed to enlarge the work greatly during the coming season.

Observations on the blossoming, leaving out, formation of terminal bud and fruiting period of plums and cherries have been continued for the Division of Pomology of the National Department of Agriculture.

During the current year a new experimental apple orchard of over two hundred trees and embracing over forty varieties has been started. It is hoped that this orchard may serve as a basis of many practical investigations in fruit culture.

Many queries were made in the spring regarding the peculiar behavior of apple trees. The trouble was described by practically all the correspondents as follows: The trees blossomed and partially or wholly leaved out, when growth was arrested and the leaves began to wither and dry up. Later on most of these trees pushed out many new shoots at the base of the scaffold limbs or on the trunk just below their juncture with it. Two orchards in which this injury was reported were examined by the writer. One was found to be in much worse condition than the other and was given a more careful study, which led to the belief that the injury was due to root-killing caused by severe winter freezing in the abnormally cold winter of 1903-04. The trees most seriously injured in the orchard mentioned were eight year old Rhode Island Greenings. The majority of these trees grew on an exposed ridge which in all probability had been largely swept of snow during the preceding winter. Experiments in severe and partial pruning back of the affected trees were inaugurated. It is expected that a report can be made in the near future as to the desirability of such treatment of winter injured trees.

The intelligent and capable assistance of Mr. Charles H. Johnson in his capacity as greenhouse assistant has greatly facilitated the horticultural work and is heartily acknowledged.

SOME PROBLEMS IN WINTER FORCING OF TOMATOES

For the past two seasons (1902-03 and 1903-04) a portion of the station greenhouse has been devoted to the forcing of tomatoes. In so far as facilities permitted investigations have been chiefly aimed at the determination of:

1. The relative productiveness of certain forcing house varieties.
2. The relative earliness of certain forcing house varieties.
3. The relative value of chemical fertilizers and rotted manure.
4. The most effective insecticidal treatment for "White Fly."

The room devoted to this work, while somewhat restricted in area, being a little over 22 feet in length by 24 in width, was so planned that considerable investigational work could be pursued. The arrangement and division of the solid bed and benches as shown in the accompanying diagram gave four equal sections in the raised side bench and three in the solid bed, with a fourth in the latter of two-thirds the width and which was designed for the pot-grown plants.

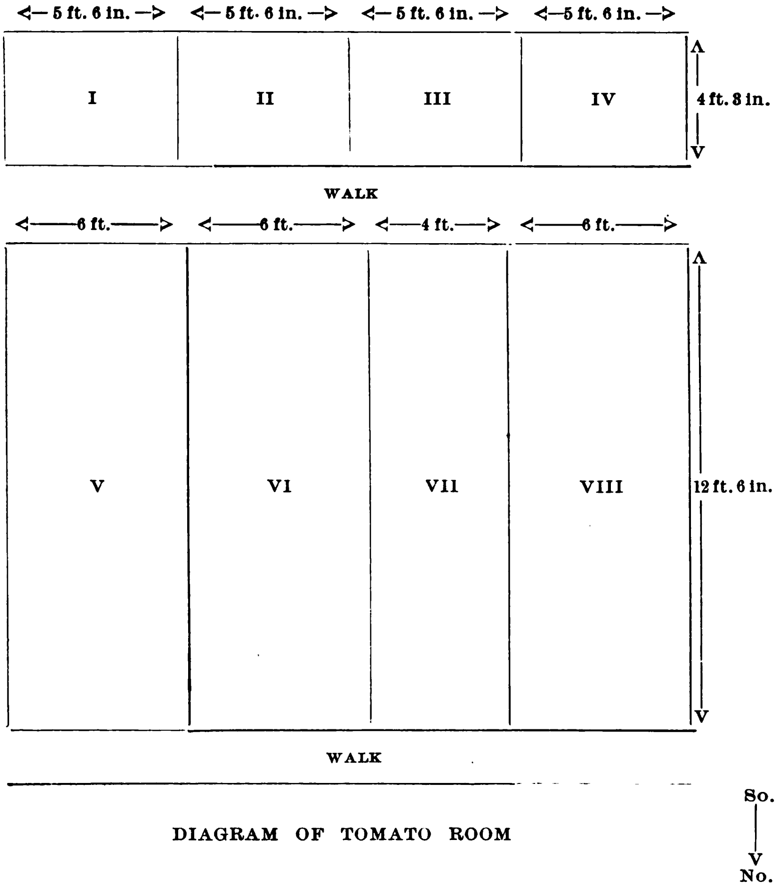

DIAGRAM OF TOMATO ROOM

Cultural features.—The method of growing and handling the plants up to the period of setting them in the bench, bed or galvanized iron pot did not differ from the usual practice. The seeds were sown in seed pans or flats. The seedlings, when of sufficient size, were transferred to 2½ inch pots, then later on shifted to 4 inch pots, and when becoming pot-bound, were planted out in the location where they were intended to fruit.

The 1902-03 crop was started from seed sown September 19. The seedlings were potted off October 16, shifted to 4 inch pots November 14 and set in permanent quarters December 2. The first ripe fruits were picked March 9. Seeds were sown for the 1903-04 crop August 5, seedlings potted off August 19, shifted to 4 inch pots September 4, and transferred to permanent quarters September 22 and 23. The first ripe fruit was picked November 20.

Soil used.—The soil used in filling the benches, beds and galvanized iron pots for the season of 1902-03 was a clayey loam obtained in an old pasture from which the sod had been stripped. This soil might be said to have been mostly subsoil, as, after removing about three inches of the surface soil, that below was taken to a depth of eight to twelve inches. This rather heavy soil was screened through a half inch wire mesh and then lightened up by the addition of about a sixth its bulk of sand. A soil was secured in this manner which, though of a somewhat poor mechanical texture, was so lacking in plant food that any application of fertilizer or manure was promptly made manifest in the resultant crop.

The soil used for the crop of 1903-04 was a compost of rotted sod obtained from the same pasture location. To this sod compost had been added about one-fifth its bulk of rotted manure, thus making what the florist would term a fairly good potting soil. To this soil, after passing it through a screen and thoroughly mixing it to insure uniformity, was added about a seventh part sand to lighten it up.

Nematodes.—The 1902-03 crop suffered somewhat from the presence of nematodes in the soil. In some instances these pests invaded the roots of a few of the plants to such an extent as to practically destroy them. Data from plants thus affected was discarded. By sterilizing the soil in which the plants were started and grown these injuries were avoided in the season of 1903-04.

I. THE RELATIVE PRODUCTIVENESS OF CERTAIN FORCING HOUSE VARIETIES

During each season comparative trials were made to determine the relative productiveness of different varieties of tomatoes grown under identical conditions. The first season's work included 78 plants of Sutton's Best of All and 74 of New Stone. During 1903-04 48 plants of each of these two varieties were grown. In addition to these, 11 plants of Lorillard and 8 of Sutton's Best of All were grown on the side bench for comparison with each other.

The number and individual weights of the fruits picked from each plant were recorded and the data thus accumulated is presented in Table I. Their separation into large and small, while purely arbitrary, was uniform for all. All fruits weighing over 50 grams were called large, while those weighing less were classed as small fruit.

TABLE I

AVERAGE YIELD OF LARGE AND SMALL RIPE FRUIT PER PLANT FROM SUTTON'S BEST OF ALL, NEW STONE AND LORILLARD TOMATOES

Crop of	Variety	Large fruit			Small fruit			Total fruit		
		No.	W't gr'ms	% gain	No.	W't gr'ms	% gain	No.	W't gr'ms	% gain
1902-03	New Stone..............	13.9	1258.3	3.9	2.7	98.4	.....	16.6	1356.7	.3
	Sutton's Best of All....	13.2	1210.4	.....	4.	141.9	44.8	17.2	1352.3	.....
1903-04	New Stone..............	13.2	1098.1	.....	4.4	168.5	7.	17.6	1266.6	.....
	Sutton's Best of All....	13.	1114.4	1.5	4.4	157.5	.....	17.4	1272.	.4
1902-03* & 1903-04	New Stone..............	13.6	1178.2	1.4	3.6	133.5	.....	17.1	1311.7	.....
	Sutton's Best of All....	13.1	1162.4	.....	4.2	149.7	12.1	17.3	1312.2	.....
1903-04	Lorillard............ ...	23.4	2396.5	14.4	2.	74.5	.....	25.4	2471.	11.6
	Sutton's Best of All....	23.5	2094.6	.....	3.3	119.6	60.5	26.8	2214.2	.....

*Combined average product of two seasons.

The exceedingly close yield of Sutton's Best of All and New Stone for the two seasons, based as it is on so large a number of plants, seems remarkable. A gain of 3.9 percent of large fruit in favor of New Stone is noted in the first season's trial. The combined weight of large and small fruits, however, shows but a fraction of a percent of gain in favor of New Stone. There is a gain of 1.5 percent large fruit in favor of Sutton's Best of All in 1903-04, and in total product of about 0.4 percent.

The combined average product of large fruits for the two seasons shows but a slight gain, 1.4 percent, in favor of New Stone. When the total product, large and small, is compared the difference is so slight that it hardly needs be taken into account. The results obtained from Lorillard and Sutton's Best of All are much more interesting because of the larger yields of fruit from the plants and also on account of the considerably increased yield of Lorillard over the former. This increase in large fruits amounted to over 14 percent, and to over 11 percent in total weight of fruit in favor of Lorillard. Sutton's Best of All showed a much larger proportion of small fruits.

Taken as a whole the trial indicates but little difference in productiveness between Sutton's Best of All and New Stone, with the advantage slightly in favor of the latter. In the case of Lorillard and Sutton's Best of All the results of one season's trial is decidedly in favor of the former.

II. THE RELATIVE EARLINESS OF CERTAIN FORCING HOUSE VARIETIES

In connection with the observations recorded on the relative productiveness it is interesting to note the comparative earliness of fruit maturity. The quality of early ripening is an important one in forcing varieties and often determines whether or not they may be thus profitably employed. The number of ripe fruits picked each month, together with their weight, appears below:

TABLE II

AVERAGE NUMBER AND WEIGHT OF FRUIT PER PLANT BY MONTHS—
1902-03

	March 9-31				April				May				June			
	Large fruit		Small fruit		Large fruit		Small fruit		Large fruit		Small fruit		Large fruit		Small fruit	
	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms
Sutton's B. of All	3.7	343.8	.6	25.4	5.8	561.6	1.3	45.5	3.9	315.2	1.7	59.4	.07	6.5	.15	4.8
New Stone........	3.4	333.6	.3	10.6	5.1	645.8	1.1	38.9	4.1	335.4	1.4	49.	.16	12.6	.06	2.

AVERAGE NUMBER AND WEIGHT OF FRUIT PER PLANT BY MONTHS—
1903-04

	Nov. 20-30				Dec. 1-31				Jan. 1-31				Feb. 1-29				March 1-			
V-VIII Sutton	1.1	110.8	...	.....	4.5	377.8	1.3	49.6	2.6	227.6	1.	35.3	3.9	327.1	1.4	47.7	1.3	102.4	.8	28.6
V-VIII N. Sto.	1.1	98.3	.03	1.	5.3	429.	1.1	40.3	3.2	296.6	1.2	46.3	2.9	238.6	1.	38.7	.8	61.3	.9	34.9
I-IV Sutton	.3	15.	.1	5.6	5.6	499.1	.8	27.	6.5	553.1	1.1	43.5	7.5	682.6	.8	26.6	3.6	319.5	.4	11.3
I-IV Lorill'd	.5	32.	...	.....	6.7	613.	.5	22.1	6.	640.2	.6	17.3	6.4	705.5	.6	23.8	3.7	405.9	.2	6.7

The average number and weight of large and small ripe fruit produced by the Sutton and New Stone plants during the first year did not vary materially. A comparison by months shows that in March, during the latter portion of which some ripe fruit was picked, Sutton's Best of All gave the better yields of both large and small fruits. The increase in large fruits was small, about 3 percent, while that in the total product was 7 percent. During April, however, the yield of large fruits from New Stone exceeded that of Sutton's Best of All by 15 percent, and in total yield by nearly 13 percent. The yield obtained during the six weeks, March 9-April 30, may be held to represent earliness of maturity, and the sum of the product ought to be a fair index of this particular varietal characteristic. This data, as presented below in Table III, shows that while the yields are comparatively close the advantage in the case of large fruits, which of course is the commercial index, is in favor of New Stone, there being a little over 8 percent gain, which is reduced to 5 percent when total yields are compared.

TABLE III

YIELD OF LARGE AND SMALL FRUITS FOR MARCH AND APRIL, 1903

	Large fruits	% gain	Small fruits	% gain	Total yield	% gain
Sutton's Best of All....	905.4 grams		70.9 grams	43	976.3 grams	
New Stone..............	979.4 "	8	49.5 "		1028.9 "	5

The same observations obtained during the second season are recorded in Table IV. The plants were started earlier in the year and their fruiting season was somewhat extended as compared with that of the preceding year. So few fruits were gathered in late November that the data has but slight value as an indication of any marked degree of earliness as compared with that obtained later. The same number of large fruits was gathered from each variety during November, but the average weight grown on Sutton's Best of All was greater by 13 percent. The November small fruit were a negligible quantity. The December large fruit yield of New Stone was over 13 percent greater than from Sutton's Best of All. The former outranked the latter in the two months as a whole in large fruit, 17 percent, and in total fruit 14 percent.

Lorillard was grown on the side bench together with some plants of Sutton's Best of All. The results thus obtained naturally cannot be compared with those secured with plants grown in the solid bed. Inasmuch, however, as the plants were grown from the same lot of seedlings as the others and set out at the same time, any increase over Sutton's Best of All may be considered indicative of a similar one over New Stone.

The amount of fruit gathered during November was so slight that it has been included in December's yield. The total yield of large fruits for the two months shows an increase of over 25 percent in favor of Lorillard, and in large and small fruits combined of 22 percent.

Summing up the results obtained it is evident that Sutton's Best of All gave a slightly larger weight of ripe fruit for the first few pickings (See Table II), but that when this period is extended over five or six weeks the results are uniformly in favor of New Stone. The opposite of this is true when the yields of small fruits are compared.

In one season's trial Lorillard proved superior in every respect to Sutton's Best of All. Lorillard is apparently the earliest and most prolific for forcing purposes of the three varieties tested.

TABLE IV

YIELD OF LARGE AND SMALL FRUITS FOR NOVEMBER AND DECEMBER, 1903

	Large fruits	% gain	Small fruits	% gain	Total yield	% gain
Sutton's Best of All....	448.6 grams		49.6 grams	20.	498.2 grams	
New Stone..............	527.3 "	17.	41.3 "		568.3 "	14.
Sutton's Best of All....	514.1 "		27. "	22.	546.7 "	
Lorillard................	645. "	25.	22.1 "		667.1 "	22.

III. THE RELATIVE VALUE OF CHEMICAL FERTILIZERS AND ROTTED MANURE

This experiment was undertaken with the idea in mind of determining, at least for our own conditions, whether rotted manure was a better source of plant food than chemical fertilizers in the production of tomatoes. To this end sections II and III and V and VI (plan page 420) were made comparable in all particulars except as to source of food supply. The soil in sections II and VI received liberal applications of chemical fertilizers, while to that in III and V a coat of rotted manure about two inches deep was applied. The amount of chemical fertilizers used on sections II and VI were as follows:

Section II 1902-03	506.9	grams acid phosphate.
	277.7	grams nitrate of soda, in two applications.
	106.3	grams muriate of potash, in two applications.
Section II 1903-04	788.9	grams acid phosphate.
	483.5	grams nitrate of soda, in four applications.
	268.9	grams muriate of potash, in three applications.
Section VI 1902-03	1539.5	grams acid phosphate.
	1142.9	grams nitrate of soda, in four applications.
	582.9	grams muriate of potash, in two applications.
Section VI 1903-04	2532.1	grams acid phosphate.
	1551.7	grams nitrate of soda, in four applications.
	862.9	grams muriate of potash, in three applications.

These amounts according to analysis represented the following number of grams of available phosphoric acid, nitrogen and potash per square foot of bench surface. In each case the total amount of acid phosphate was applied to the soil previous to setting the plants, whereas only partial amounts of the nitrate of soda and muriate of potash were added at that time, the balance being applied in liquid form during the growth of the plant. The comparison as to the two sources of plant food is based wholly upon the resultant crop of fruit. In the data presented in the tables the following points are contrasted: (1) The acceleration of the ripening period; (2) Increased size of fruit; (3) Proportion of large to small fruits and average weight of same.

TABLE V

Number of section	Year	Available amounts per square foot of		
		Phosphoric acid	Nitrogen	Potash
II	1902-03	3.2 grams	1.6 grams	2.8 grams
II	1903-04	5. "	3. "	6. "
VI	1902-03	3. "	2. "	4. "
VI	1903-04	5. "	3. "	6. "

Acceleration of the ripening period.—The observations which form the basis of the preceding discussion are of service here except that they are confined to the plants grown in the special sections. Variety cuts no figure since the same number of plants of each sort were grown in each section. The data presented in Tables VI and VII show average yields of large and small fruit per plant for each month of the fruiting season.

TABLE VI—1902-03

ACCELERATION OF RIPENING PERIOD DUE TO DIFFERENT SOURCES OF PLANT FOOD

Number section	March				April				May				June			
	Large fruit		Small fruit		Large fruit		Small fruit		Large fruit		Small fruit		Large fruit		Small fruit	
	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms
II, Chem. fertilizers.	5.8	702.8	.4	14.4	5.6	586.6	1.6	44.8	5.6	521.4	2.2	93.	...	.....	...	.....
III, Manure............	8.2	730.	.8	33.6	8.	768.6	2.2	71.2	5.2	396.4	2.4	75.	...	.....	.8	27.6
V, Manure............	3.7	331.3	.4	14.6	6.1	618.2	1.3	41.2	4.5	381.8	1.3	45.	.09	6.8	...	.....
VI, Chem. fertilizers.	3.	261.1	.3	11.6	6.2	565.9	.7	27.5	4.5	359.9	1.	36.5	.1	16.6	.03	1.4

TABLE VII—1903-04

ACCELERATION OF RIPENING PERIOD DUE TO DIFFERENT SOURCES OF PLANT FOOD

No. Sec.	November				December				January				February				March			
	Large fruit		Small fruit		Large fruit		Small fruit		Large fruit		Small fruit		Large fruit		Small fruit		Large fruit		Small fruit	
	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms	No.	W't gr'ms
II,C.F.	.8	49.	...	.....	6.2	500.2	1.4	54.	5.6	466.8	1.4	57.6	8.6	857.8	.8	29.8	4.6	486.6	.4	14.8
III, M.	...	.....	...	.....	6.	597.6	.2	9.	7.6	767.4	1.	37.6	4.8	473.6	.6	25.	4.6	488.2	.4	11.
V, M.	1.1	105.7	...	.....	5.2	433.7	.9	30.6	3.2	285.3	1.	36.4	3.9	338.6	1.7	61.4	.8	52.3	1.	35.9
VI,C.F	.8	56.4	.07	8.7	4.2	312.3	1.7	63.5	2.6	209.9	1.4	50.9	3.3	272.5	.6	25.7	1.5	116.4	.9	36.3

An examination of this data shows that in March, 1903, section III (rotted manure) gave an increase of nearly 4 percent of large fruit over its twin section II (chemical fertilizer), and that in April the increase was over 31 percent. During May, however, the figures are reversed, the chemical fertilizer section showing an increase of over 31 percent. The total yield of large fruit for the season was 4.5 percent greater when the rotted manure was used, and of large and small fruit together 7 percent greater.

The same sections afforded results very similar to these in 1903-04. The yield of large fruit picked from November 20 to December 31 shows an increase of over 8 percent in favor of the rotted manure. The January yields are also decidedly in favor of the rotted manure, there being an increase of 67 percent of large fruit. The average yields of large fruit from November 20 to January 31 favor the use of rotted manure to the extent of over 34 percent. Or if we take the total yield of large fruits for the season we find a slight gain in favor of the chemical fertilizer section of less than 1.5 percent. The total yield of large and small fruits from the two sections shows a little over 4 percent gain in favor of the chemical fertilizers. This amount, while not large, indicates that the later applications of nitrate and muriate increased the yield in the latter part of the fruiting season.

The rotted manure used on section V excelled the chemicals used on VI during the first season both in earliness and in total yield, the increase being of large fruit in March, 27 percent, in April, 9 percent, and in May, 6 percent, a total increment of 11 percent. The crop of 1903-04 from the same sections shows an increase for November and December combined of 46 percent of large fruit, for January of nearly 36 percent, and in total yield for the season of over 25 percent in favor of the rotted manure. Computing the total increase of large fruit for the two seasons, the rotted manure treatment proved superior by over 15 percent.

Summing up these results we find that the average yield of large fruits during the early part of the fruiting season was invariably greater from the sections to which rotted manure was applied, thereby indicating the greater effectiveness of the natural plant food. Taking the crop as a whole there appears to be no particular advantage in favor of either in the case of sections II and III, but a decided one in favor of rotted manure when sections V and VI are compared. The reason for this is not evident unless more or less leaching of the manure occurred on the raised bench, which in the solid bed was retained. In the case of the fertilizer section the later fractional applications of nitrate and of muriate prevented any appreciable leaching.

Increased size of fruit.—The relation of plant food to size of fruit and to earliness was found to be closely allied with each other. Taking the data obtained during the same period of time as that covered in the discussion on earliness we find that with but a single exception (section II, 1902-03) the larger fruits were obtained from the rotted manure sections. Viewed as a whole the results indicate that rotted manure favors the production of larger fruits.

TABLE VIII

		Average weight of large fruits for March and April, 1902-03.	Nov., Dec. and Jan., 1903-04.
Section II	Chemical fertilizers	113. grams	81. grams
Section III	Rotted manure	93. grams	100. grams
Section V	Rotted manure	97. grams	87. grams
Section VI	Chemical fertilizers	80. grams	76. grams

Proportion of large to small fruits.—In comparing the proportion of large to small fruits only the average number and weight of fruits per plant for the season are given. These, as shown in Table IX, indicate highly variable results, particularly in the ratio of large to small fruits. The average ratio for the chemical fertilizer sections was 4.6 to 1, while that for the rotted manure sections was 4.5 to 1.

TABLE IX

AVERAGE NUMBER AND WEIGHT OF FRUIT PER PLANT FOR THE SEASON

			No. large	No. small	Ratio	W't large grams	W't small grams	Ratio
1902-03	Section II	Chem. fert.	17.	4.2	4. :1	106.5	36.2	3. :1
	Section II	R. manure	21.4	6.2	3.5 :1	88.5	35.5	2.6 :1
	Section V	R. manure	14.4	3.	4.8 :1	92.9	33.6	2.8 :1
	Section VI	Chem. fert.	13.8	2.	6.9 :1	87.2	38.5	2.3 :1
1903-04	Section II	Chem. fert.	25.8	4.	6.5 :1	89.8	39.5	2.3 :1
	Section III	R. manure	23.	2.2	10.5 :1	101.2	37.5	2.7 :1
	Section V	R. manure	14.2	4.6	3.1 :1	85.6	33.7	2.4 :1
	Section VI	Chem. fert.	12.4	4.7	2.6 :1	78.	38.3	2. :1

The average weight of the individual large fruits for the season were with one exception greater from plants grown in the rotted manure sections than from those grown with chemical fertilizers. The average weight of large fruits for the two seasons was 90.4 grams from chemical fertilizers and 92 grams from rotted manure. On the same basis the average number of large fruits per plant from the chemical fertilizer sections were 17.3 as against 18.3 from plants grown in rotted manure sections. This shows an average gain in weight of fruit per plant of nearly 8 percent in favor of the rotted manure sections.

As a result of this comparison of the relative efficiency of rotted manure and chemical fertilizers in tomato culture, the following deductions may be stated: (1) the ripening period of the fruit from plants grown in soil enriched with rotted manure was slightly accelerated and the size of the fruit somewhat increased; (2) the proportion of large to small fruits was practically the same; (3) the average number of large fruits was slightly greater from the rotted manure sections.

IV. THE MOST EFFECTIVE INSECTICIDAL TREATMENT FOR THE WHITE FLY

The white fly (*Aleyrodes vaporariorum*) has proved one of the most serious insect pests encountered in the winter forcing of tomatoes for the reason that it does not succumb to the ordinary remedies such as are employed against red spider, aphis and thrips. This immunity to the ordinary fumigants such as tobacco stems or dust, aphis punk, nicoticide, and sulphur fumes, or to the liquid insecticides applied as a spray, is largely due to the fact that during its immature stages of existence it is less easily destroyed than are the other pests mentioned. The crop was started rather late in the season of 1902-03, and hence fewer insects appeared on the young plants than occurred the next year and they were more easily managed.

Remedies employed.—Frequent fumigation with "Nicoticide" did not entirely rid the plants of the fly during 1902-03, but kept it from great increase or from actually doing serious injury. In 1903-04, however, the plants being started earlier and the insects seemingly more prevalent, fumigations with "Nicoticide" seemed to be of slight avail. Trials were made of "Aphis Punk" with meagre results. "Fir-tree Oil," "Lemon Oil," "X-all" and soap solutions were next tried, at strengths in some cases considerably in excess of those recommended, but with little avail, as the insects seemed to increase rather than decrease. It was decided as a last resort to try hydrocyanic acid gas fumigation.

Hydrocyanic acid gas is generated by the action of sulphuric acid on potassium cyanide in earthenware or glass jars. The gas which is immediately evolved is poisonous to all animal life and precaution is needed in using it. *No one should make use of it who does not understand its deadly possibilities and is not informed as to the precautions.* It was decided to use a milder dose in fumigating the tomato room than that generally recommended and to leave the room closed over night, thereby subjecting both plants and insects to prolonged exposure. Ordinarily a stronger dose is used and the ventilators are opened after half an hour's exposure. With the weaker treatment and the longer exposure no precautions were found necessary when entering the closed room the following morning. The dose employed at first was at the rate of 0.2 grams of 98 percent potassium cyanide to each cubic foot of air space, or at the rate of about two-thirds of an ounce to each 1,000 cubic feet. The room fumigated contained approximately 3,500 cubic feet, hence 70 grams (2.5 ounces) of potassium cyanide were required. One-half as many more cubic centimeters (105 c. c.) of sulphuric acid, diluted by the addition of one and a half times its bulk of water (225 c. c.) was used to evolve the gas. The water being put in the jar first and the acid next (not acid first and water next), the required amounts of cyanide enclosed in a paper bag and suspended over the jar by means of a cord connected with the exit, is lowered by the operator into the jars without danger. This procedure is unnecessary when the jar is near the exit, as the operator, by taking the precaution not to inhale a breath when dropping the package into the jar, may get out of the room without any risk. The former procedure, however, is the safer.

Fumigation with the dose mentioned destroyed both the nymph and adult forms of the insect and did no injury to the bearing plants. In all cases the room was fumigated in the evening and remained closed until the following morning.

In fumigating a second crop of plants just beginning to blossom and set fruit, it was thought best because of the tenderness of the plants to use a weaker dose, the amount being cut down to about .014 grams potassium cyanide per cubic foot, or 50 grams to the room. Notwithstanding this very material decrease in amount of cyanide used, considerable injury was done, for the most part confined to the tender growing shoots and blossoms. This outcome seems in part due to the higher temperature of the house during the fumigation, it having stood at 70° F. instead of 60-65° as at the first treatment. This tendency to injury in high temperature fumigations is corroborative of observations made by others. Subsequent trials with the same strength at lower temperatures did no injury to the plants, yet destroyed the insects. Cucumbers, lettuce and a mixed lot of plants have been fumigated in the same manner as just outlined with equal satisfaction. Fumigation with light doses, ½ ounce per 1,000 cubic feet of air space, at temperatures not over 60-65° F. and long exposures is effective, and, in the hands of the ordinary person, is perhaps on the whole more satisfactory than strong doses and short exposures as a remedy against the white fly.

SOME STUDIES IN INDOOR LETTUCE CULTURE

Studies in the indoor culture of lettuce were conducted in the station greenhouse during the seasons of 1902-03 and 1903-04. They have to do with: (1) The comparative value of different forms of chemical fertilizers; (2) The relative value of chemicals and rotted manures; (3) The relative influences of surface and sub-watering.

The lettuce room is about 35 by 24 feet and its arrangement is similar to that of the tomato room, having the raised side bench and the solid centre bed. The side bench was divided into six sections, all of which were arranged for sub-watering, four of these being of equal size and the remaining two smaller. The centre bed was divided into four equal sections, one of which was fitted up for sub-watering, according to the method described by the writer[1] when connected with the Indiana station.

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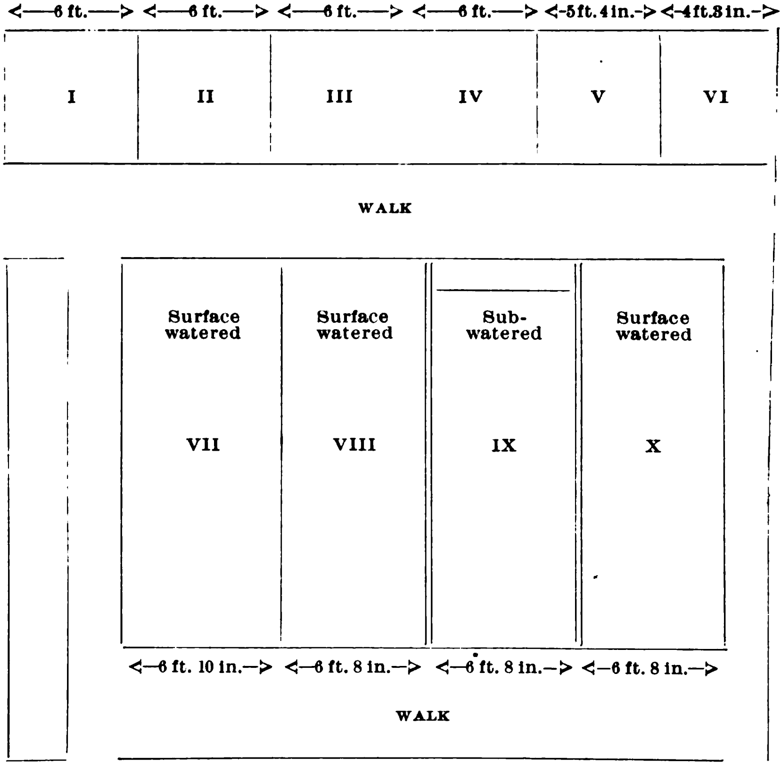
[1] Stuart, Ind. Sta. Bul. 66, p. 54-55 (1897).



<—6 ft.—> <—6 ft.—> <—6 ft.—> <—6 ft.—> <-5 ft. 4 in.-> <-4 ft. 8 in.->
I
II
III
IV
V
VI
WALK
Surface watered
Surface watered
Sub-watered
Surface watered
VII
VIII
IX
X
<—6 ft. 10 in.—> <—6 ft. 8 in.—> <—6 ft. 8 in.—> <—6 ft. 8 in.—>
WALK
So
No.

DIAGRAM OF LETTUCE ROOM

Soil used.—The soil used in the lettuce benches and beds was identical with that employed for the tomatoes and was prepared in a similar manner, being very poor the first and rich the second season (see page 421).

Cultural details.—Seeds[1] were sown in seedpans or flats and the plants, when of sufficient size, were potted off instead of being pricked out in flats or in the bench, as is common under commercial conditions. There was less likelihood of injury to plants thus treated when setting them out in the bench or bed, each plant having a like ball of earth and roots. A larger number of plants than were actually required were potted and the best and most uniform were chosen and distributed in each section as the selection proceeded. Thus the plants in each section were as nearly comparable as it was possible for eye-judgment to make them. All plants were set approximately 8x8 inches apart. In cutting for market a like number of plants were cut from each section included in any given experiment; hence while the harvesting period usually extended over one to two or more weeks the relative increase in weight was the same in each section. In this way any change in product could be reasonably assumed to be due to differences in plant food or moisture supply, or, in the case of surface and sub-watering, to changed physical condition of soil. Two crops were grown each season.

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[1] Grand Rapids variety. A few plants of head lettuce were grown, but no account of these is made in the discussion.

I. THE COMPARATIVE VALUE OF DIFFERENT FORMS OF CHEMICAL FERTILIZERS

The side bench was arranged for sub-watering with the idea of devoting it to experimental studies on the influence of different forms of plant food chemicals in the culture of lettuce. The amount of fertilizer added was computed on the basis of so many grams of available phosphoric acid, nitrogen and potash to each square foot of bench surface. For example, the application of fertilizers to the first crop was intended to be made on the basis of 4 grams phosphoric acid, 3 grams of potash and 2 of nitrogen per square foot, but owing to the amounts taken being based on their guaranteed rather than their actual content, these figures were found to have been exceeded in some instances and to be slightly less in others. The actual amounts applied are shown below. Section I was designed to serve as the control, the

TABLE XII

FERTILIZERS APPLIED TO FIRST CROP LETTUCE—1902-03

Number of section	Amount and kind of fertilizer	Available amount per sq foot. in grams		
		Phosphoric acid	Nitrogen	Potash
I.	None.			
II.	600.4 grams acid phosphate....	4.2	...	...
	280. grams nitrate soda*......	...	1.8	...
	126. grams muriate potash†...	...	...	3.1
III.	600.4 grams acid phosphate....	4.2	...	...
	350. grams dried blood.......	...	2.	...
	126. grams muriate potash† ..	...	...	3.1
IV.	600.4 grams dis. boneblack.....	4.7	0.1	...
	261.2 grams nitrate soda*	...	1.7	...
	126. grams muriate potash† ..	...	...	3.1
V.	1120. grams raw bonemeal.....	5.5	1.4	...
	58.1 grams nitrate soda*	..	0.4	...
	112. grams muriate potash† ..	...	...	3.1

* 4 applications. † 2 applications.

product from which would represent the normal yield from the plant food contained in the soil used. In sections II and III a comparison was made between the relative availability of inorganic and organic nitrogen. Sections IV and V were designed for comparison with II and with each other.

First crop.—Seeds for the first crop were sown September 23, potted off into two and one-half inch pots October 11, transferred to the bench November 19 and harvested in late January and early February. Each plant was cut at the surface of the ground and weighed. Forty-five plants were grown in each of the first four sections and forty in section V. The results show a marked gain, varying from 44 to over 81 percent when chemicals were used. The yields on sections II and III were closely alike; section IV gave the poorest results and section V (raw bonemeal) gave much the largest increase., due presumably to the much larger application of phosphoric acid.

TABLE XIII. FIRST CROP, 1092-03

Section I.	Average weight per plant	84.	grams		
Section II.	Average weight per plant	125.9	grams	Percent increase	50
Section III.	Average weight per plant	126.3	grams	Percent increase	50
Section IV.	Average weight per plant	120.9	grams	Percent increase	44
Section V.	Average weight per plant	152.5	grams	Percent increase	82

The second crop was started from seed sown December 24, potted off January 10, set in beds February 14 and harvested the latter part of March and first week of April. No change of soil was made for this crop. It was simply dug up and pulverized and an application of fertilizers made, the amount used being one-half of that used with the first crop, all of which, with the exception of nitrate, was applied directly to the soil. The nitrate was applied in two equal parts. The weight of the second crop, save that in the unfertilized section, was somewhat larger than the first. The smaller yield of the control plants greatly swells the percentages of increase. The increase of II over III —about 3 percent—is too slight to lay stress upon. Section IV (dissolved boneblack) gave very much better results than in the preceding crop, the yield being practically identical with that on V. As compared with sections II and III the increases were approximately 9 and 12 percents respectively.

TABLE XIV. SECOND CROP, 1902-03

Section I.	Average weight per plant	42.9	grams.	Percent increase	....
Section II.	Average weight per plant	141.	grams.	Percent increase	229.
Section II.	Average weight per plant	136.6	grams.	Percent increase	218.
Section IV	Average weight per plant	153.3	grams.	Percent increase	257.
Section V.	Average weight per plant	153.5	grams.	Percent increase	258.

In 1903-04 a break in the continuity of the experiment was made in so far as it pertains to sections V and VI, owing to the use of a different type of soil, a garden soil in which lettuce had grown luxuriantly that season being used. Increased amounts of nitrate and muriate were given to all sections receiving these forms of plant food, there being half as much again of nitrogen and twice as much potash used. Sections II and III compared acid phosphate and dissolved boneblack, and III and IV the availability of organic nitrogen with nitrate nitrogen. Sections V and VI were alike except as to source of phosphoric acid.

TABLE XV.

FERTILIZERS APPLIED TO SECTIONS I, VI, 1903-04, FIRST CROP

Number of section	Amount and kind of fertilizer	Available am't per sq. ft. in grams		
		Phosphoric acid	Nitrogen	Potash
I.	None.			
II.	567.2 grams acid phosphate	4. grams	....	....
	450. grams nitrate soda*	....	3. grams	....
	241.6 grams muriate potash†	....	....	6. grams
III.	505.2 grams diss. boneblack	4. grams	....	....
	441. grams nitrate soda*	....	3. grams	....
	241.6 grams muriate potash†	....	....	6. grams
IV.	505.2 grams diss. boneblack	4. grams	.04	....
	528.5 grams dried blood	....	2.96	....
	241.6 grams muriate potash†	....	....	6. grams
V.	812. grams raw bonemeal	4. grams	1.2	....
	227. grams nitrate soda†	....	1.8	....
	212.8 grams muriate potash†	....	....	6. grams
VI.	360.8 grams diss. boneblack	4. grams	....	....
	315. grams nitrate soda*	....	3. grams	....
	172.6 grams muriate potash†	....	....	6. grams

* 3 applications. † 2 applications.

The plants used were grown from seed sown September 1, potted off September 17 and transferred to the sections October 14. The first harvest was made on November 25. A further cutting was made on the 28th and the balance was removed December 1. The average yield was much less than was obtained from the crops of the first season when chemicals were applied, and much more from the control section. The soil of sections V and VI being unlike that used in sections I-IV, the results are not comparable (sections II, III and IV). There is a direct loss of from 7 to 14 percent on applying chemicals to a soil already fairly well supplied with plant food.

TABLE XVI

FIRST CROP LETTUCE 1903-04, SECTIONS I-VI

			Percentage increase or decrease
Section I.	Average weight per plant	122.8 grams	
Section II.	Average weight per plant	113.8 grams	— 7.3
Section III.	Average weight per plant	105.6 grams	—14.
Section IV.	Average weight per plant	114.5 grams	— 6.8
Section V.	Average weight per plant	141.7 grams	+15.4
Section VI.	Average weight per plant	134.4 grams	+ 9.5

A much smaller application of chemicals was made for the second crop (2 grams phosphoric acid, 1 gram nitrate and about 2. 5 grams potash per square foot). Acid phosphate was substituted for dissolved boneblack in section VI. The plants used in setting out the sections were from seed sown November 6, potted off November 18 and transferred to the bench January 9. The crop was harvested February 20-26.

The results are even more emphatic than those obtained with the first crop and are in the same direction, i. e. shortages of from 11 to 15 percent as compared with the control plot. Sections V and VI, on unlike soil, also show a decrease. The increased weight of plants of the second crop may be attributed to the season, since crops of this character make a fuller growth during the lengthening days of late winter than during the shortening ones of November and December.

TABLE XVII. SECOND CROP OF LETTUCE, 1903-04

			Percent of decrease
Section I.	Average weight per plant	= 139.5 grams	
Section II.	Average weight per plant	= 122.2 grams	—12.2
Section III.	Average weight per plant	= 118.8 grams	—14.8
Section IV.	Average weight per plant	= 124.1 grams	—11.
Section V.	Average weight per plant	= 127.9 grams	— 8.3
Section VI.	Average weight per plant	= 135.1 grams	— 3.1

As a whole the result of the second season's work corroborates some of the work with tomatoes, in that it emphasizes the fact that liberal application of chemicals to soils already well supplied with plant food is not likely to afford satisfactory results.

The average results of the first season's work from each group of fertilizers appear below. The combined data of the two crops shows a fairly definite relation between the amount of available phosphoric acid applied and the resultant weight of the crop. If it is assumed that the applications were always in excess of actual requirements, then the excess of dissolved boneblack and the raw bonemeal may be ignored. If such assumption be allowed then the increased weight of product from the groups mentioned may be attributed to the particular source of phosphoric acid.

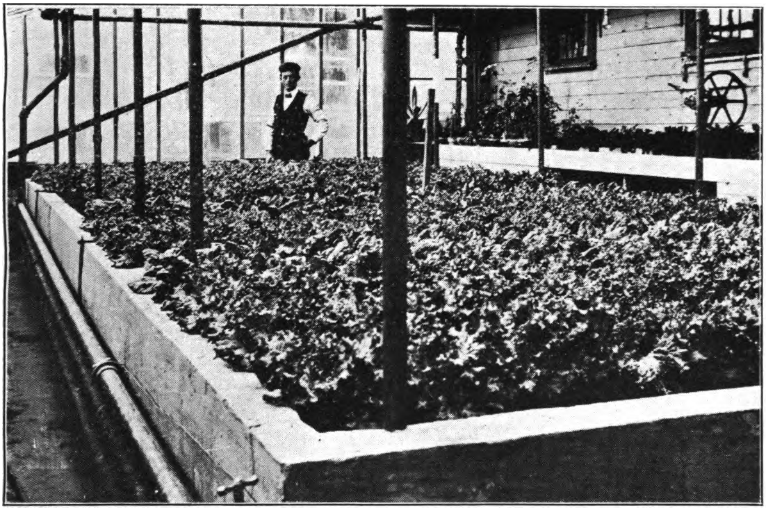


Fig. 1. Grand Rapids lettuce ready to harvest, Nov. 24, 1903.

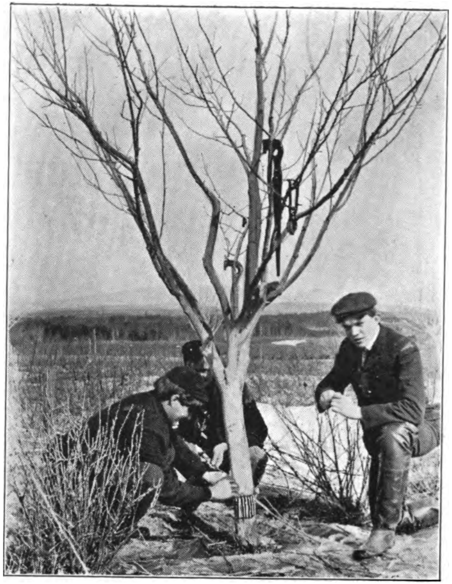


Fig. 2. Students bridge-grafting a badly girdled apple tree. March 24, 1904.

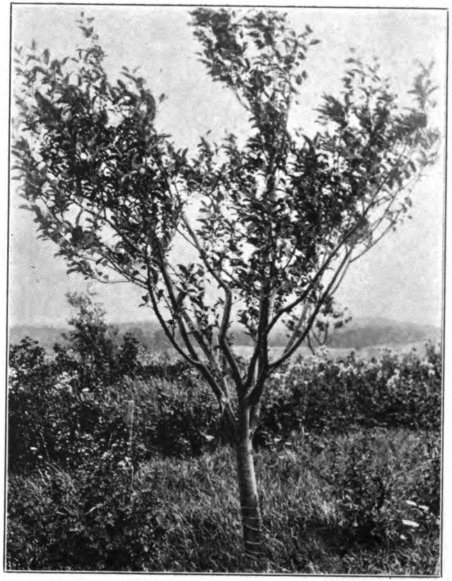


Fig. 3. Same tree as shown in figure 2. Aug. 1, 1904.

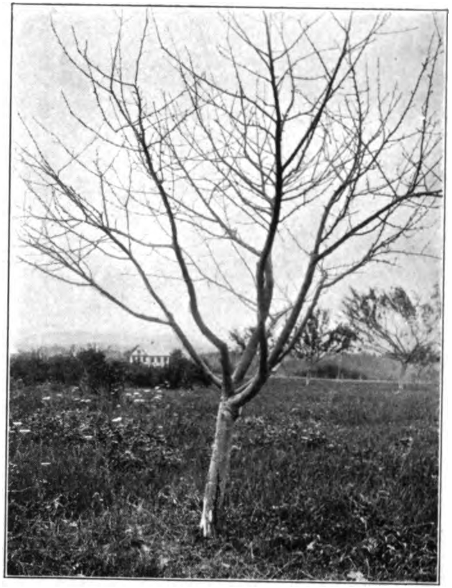


Fig. 4. Girdled tree not bridge-grafted. Aug. 1, 1904.

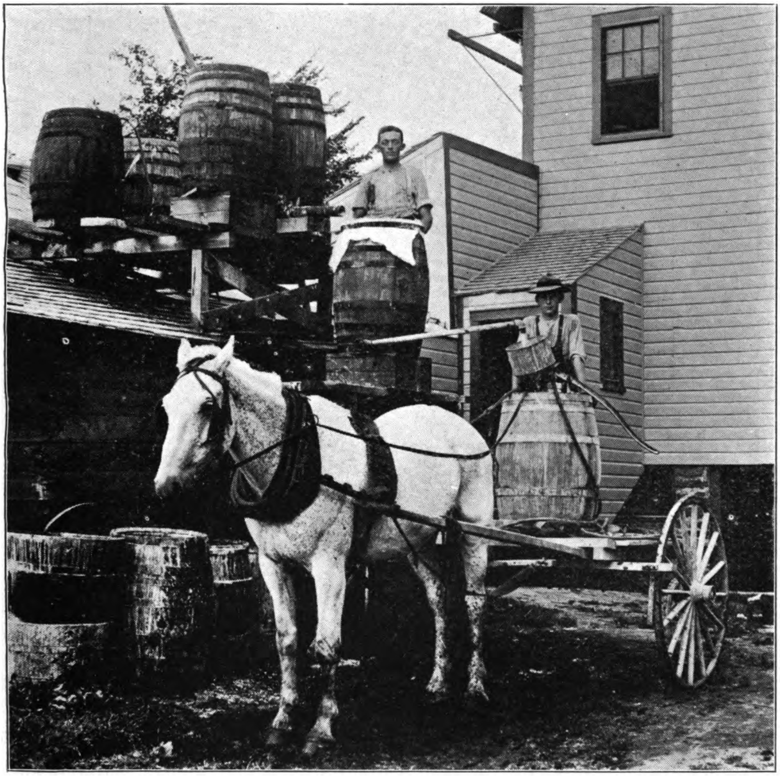
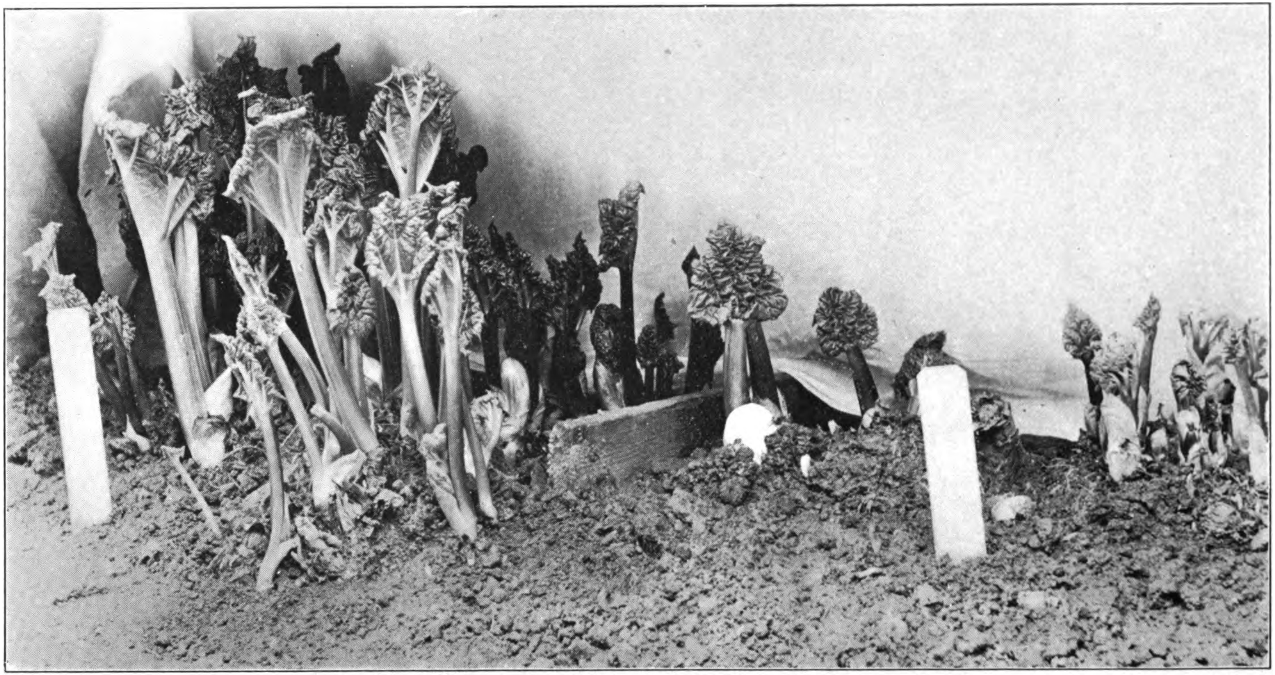


Fig. 5. Bordeaux spray-mixing outfit.



Treated. *Untreated.*

Fig. 6. Etherization of rhubarb. Etherized Jan. 9-11, 1904; photographed Feb. 1.

TABLE XVIII

Section No.	Character of fertilization	Average yield per plant
II	Acid phosphate, nitrate of soda and muriate of potash..	133. grams
III.	Acid phosphate, dried blood, muriate of potash..........	131. "
IV.	Dissolved boneblack, nitrate of soda and muriate of potash	137. "
V.	Raw bonemeal, nitrate of soda and muriate of potash..	153. "

The average results from groups II and III are so nearly alike that they may be considered identical. Section IV shows a slight gain over II and III of 3 to 4.5 percent respectively, while from section V the increase over II, III and IV is 15, 16 and 12 percents respectively.

II. THE RELATIVE VALUE OF CHEMICALS AND ROTTED MANURE

The centre bench was arranged with particular regard to testing the relative efficiency of chemicals and rotted manure in the forcing of lettuce. The two sections devoted to this test were the adjoining ones, VII and VIII, and were in all respects similar except as to source of food supply. Each held 150 plants. Like the preceding test of different forms of fertilizers the work extended throughout both seasons. Only one crop was grown for comparison the first season. From two to three inches of rotted manure was applied to section VII in 1902-03, while section VIII received an application of 1886.9 grams dissolved boneblack, 880 grams nitrate of soda and 360 grams muriate of potash, these amounts being the same relatively as those applied to the side bench sections.

Crop of 1902-03.—Seed was sown September 23, potted off October 11, and set in the bed November 19. The plants were ready to harvest January 23. The average weight of the plants were closely alike (VII, 105.8 grams; VIII, 104.3 grams).

First crop, 1903-04.—The application of fertilizers to section VIII was made on the basis of 4 grams available phosphoric acid, 3 grams nitrogen and 6 grams potash per square foot. Seed was sown September 16, potted off September 30, set in the bed October 24 and harvest made December 7-26. The average weight of the plants (VII, 99.8 grams; VIII, 88.9 grams) show an increase in favor of the rotted manure of over 12 percent.

Second crop, 1903-04.—Fertilizers were applied to section VII at the rate of 2 grams available phosphoric acid, ½ gram nitrogen and about 1 gram of potash per square foot. Section VII received three bushels of rotted manure. Seed was sown November 6, potted off November 27 and planted out January 1. The crop was harvested February 27 to March 14. The yield of the two sections (VII, 159.4 grams; VIII, 151.1 grams) while fairly close, shows an increase of over 5 percent in favor of the rotted manure. An average of the three crops should be a fair index of the relative merits of the two sources of plant food. The average weight of plants from section VII (rotted manure) was 122 grams and from VIII (chemicals) 115 grams, an increase in favor of the former of 6 percent.

III. THE RELATIVE INFLUENCES OF SURFACE V. SUB-WATERING

Some years ago the writer, then of the Indiana station, conducted experiments along this line with lettuce grown in pots, but not on a large enough scale to make the trials as conclusive as could be wished. The conditions under which the work herein discussed were conducted more nearly represents those obtaining in commercial culture. Sections VIII and IX were made comparable in every respect except as to watering. Dates of planting, etc., were identical with those already given for sections VII and VIII (page 437).

TABLE XIX

AVERAGE WEIGHT OF PLANTS FROM SECTIONS VIII AND IX, 1902-03, 1903-04

First crop,	1902-03.	Section VIII surface watered	104.3	grams
	1902-03.	Section IX sub-watered	111.9	"
Second crop,	1902-03.	Section VIII surface watered	127.3	"
	1902-03.	Section IX sub-watered	140.6	"
First crop,	1903-04.	Section VIII surface watered	88.9	"
	1903-04.	Section IX sub-watered	127.7	"
Second crop,	1903-04.	Section VIII surface watered	151.1	"
	1903-04.	Section IX sub-watered	162.7	"

The results from both crops and both seasons are without exception in favor of the sub-watered section. The average weight per plant in section VIII (surface watered) was 118 grams and in section IX (sub-watered) 136 grams, an increase in favor of the latter of 15 percent. This is less than that obtained by the writer in Indiana[1] or in trials conducted by others[2] in which gains of 25 to 100 percent have been secured; but it is enough to demonstrate the superiority of the sub-watering system.

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[1] Stuart, Ind. Sta. Bul. 85, p. 137 (1900).

[2] Green, W. J. and E. C., Ohio Sta. Bul 61, p. 75 (1895); Rane, W. Va. Sta. Bul. 33, p. 264 (1893); Goff and Cranefield, Wis. Sta. Rpt. 13, p. 247 (1896).

SUMMARY

1. The results of a comparison of the relative efficiency of different forms of chemical fertilizers while somewhat obscure, indicates that large applications of raw bonemeal produced a decided increase in weight of product; and that there is but little choice between dried blood and nitrate of soda.

2. Soil liberally dressed with rotted manure gave slightly better results than similar soil enriched with chemical fertilizers.

3. Sub-watered soil gave a larger crop of lettuce than did that which was surface-watered.

BRIDGE-GRAFTING A GIRDLED APPLETREE.

Many fruit trees were girdled by mice or other rodents during the winter of 1903-04. The extent of injury varied from a partial to a complete girdling of the trunk of the tree at or near its base. In many instances the bark was eaten off down to or below the surface of the ground and in some cases extended upward six to twelve inches. It is a little difficult to practice bridge-grafting in such extreme cases because the lower portion of the wound is inaccessible, but if it can be kept covered and moist until the ground thaws out the process is made much easier by digging away some of the soil from the base of the trunk.

The process of bridge-grafting consists in connecting or bridging over the girdled portion by means of cions, or small branches, which may be taken from the same tree or any other apple. The usual method is to cut back the upper and lower edges of the girdled bark to live healthy tissue, after which triangular shaped clefts or notches are made in the edge of the freshly cut bark. The cions are then made to fit these notches, taking care to cut them a little longer than the space they are to span in order that they may be held more firmly when sprung into place. Another method is that of cutting notches through the bark an inch or two above and below the girdled portion and cutting the cions to fit. The only precaution necessary to observe in setting the cion is to have as much of its cambium layer as possible come in contact with that of the girdled tree. While the insertion of five or six cions in a six inch tree would probably furnish a sufficient flow of sap to keep the tree alive, a larger number is preferable, for the more quickly will the injury be repaired. After inserting the cions it is good practice to wax[1] all exposed cut surfaces and then to bind up the cions with waxed cloth as shown in Fig. 2, thus excluding light and air and preventing drying out.

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[1] Ordinary grafting wax was used and the cions were bound up with a strip of cotton cloth, after which the whole surface was painted over with melted grafting wax.

The process of and results attained by bridge-grafting in the hands of the junior class, March 24, 1904, are shown in Figures 1-3. Several trees were treated in the manner shown in Fig. 1; Fig. 2 shows this same tree as it appeared August 1, 1904. The healthy appearance of the tree is in direct contrast to that shown in Fig. 3, which was no worse injured than the former but which received no care.

Bridge-grafting is the only sure method of saving badly girdled trees, and in most cases is a comparatively simple process. Where the tree is not completely girdled, mounding up with soil over the injured portion to exclude air and keep the parts moist will in many cases enable nature to repair the injury by growing a new layer of bark and wood over the injured part.

THE PREPARATION OF BORDEAUX MIXTURE.

Bordeaux mixture is perhaps the most common and universally employed of fungicides. Moreover it is probably more often mismade and misused than any other fungicide, because people who use it are not apt to provide the necessary facilities for properly making and applying it.

The horticultural department has devoted considerable attention during the past two seasons to simplifying the labor of making bordeaux mixture. Two objects were in view:

1. To avoid lifting so far as practicable.
2. To promote the formation of a fine precipitate, and, therefore, of a perfect mixture.

It has been demonstrated at this Station[1] and by others[2] that when dilute solutions of lime and copper sulphate are brought together in equal proportions, that is to say, both brought together simultaneously in a third vessel, the precipitate formed is so finely divided that it remains in suspension a much greater length of time than when a strong solution of one and a weak or strong one of the other are thrown together. Anyone in the least conversant with the use of bordeaux mixture readily recognizes that a mixture which holds the solid particles in suspension for a considerable length of time is superior to one from which they separate quickly.

A gravity system.—To obviate the necessity of lifting the mixture when filling the spray pump barrel a lean-to shed was made to serve the purpose of a temporary support to a two-tier stage or platform. On the upper platform were disposed the barrels which were intended for stock solutions of lime and copper sulphate, and, also, those in which these solutions were to be diluted preparatory to mixing in the third vessel on the platform below. These dilution vessels were provided with good sized faucets which were brought sufficiently close together to allow the liquid flowing from both at the same time to be caught in a spout which emptied into the barrel on the lower level. The two solutions simultaneously flowing into this spout form bordeaux mixture during their flow into the spout, the precipitate being extremely fine and passing through the cheesecloth strainer. A pipe with a valve protruded at right angles from the mixing vessel to the spray pump barrel, which by means of an ell and short pipe conducted the prepared bordeaux mixture into the barrel. In this way a perfect mixture is obtained, since the reaction takes place in the short spout and on the strainer and is continued by the agitation in the mixing barrel. The stock solutions only need be lifted. This system is best used where water pressure is available to carry the water to the upper platform. It is conceivable, however, that if such a platform were built near a well, by increasing the length of the pumpstock, the water could be raised to the desired level with little extra effort and that thus much of the drudgery of making bordeaux mixture would be eliminated, besides securing the additional advantage of a perfectly prepared mixture.

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[1] Vt. Sta. Rpt. 9, pp. 88-92 (1895);

[2] Swingle, U. S. Dept. Agr., Farm. Bul. 38 (1895).

Stock solutions.—Much time may be saved in the preparation of considerable quantities of bordeaux mixture if stock solutions of lime and copper sulphate are prepared in advance. In the work performed at this Station 50 pounds of copper sulphate are dissolved in 50 gallons of water in one vessel, while a like number of pounds of lime are slaked and diluted with as many gallons of water in another. The formula used in making the bordeaux is the so-called 1-10 formula, that is, 1 pound of copper sulphate or of lime, as the case might be, to every 10 gallons of water. Hence in making up 50 gallons of bordeaux 5 gallons each of the stock solutions contained the required amounts of these ingredients. These are diluted to 25 gallons each, after which the faucets are opened and the whole process becomes self-operative even to the filling of the spray tank.

Some authorities recommend stronger stock solutions, 2 pounds copper sulphate to each gallon, while others claim that a saturated solution (about 3 pounds of the copper sulphate per gallon) is the better one to use. The advantage of a saturated solution lies in the fact that it is always of a constant strength, as evaporation simply entails the precipitation of a proportionate amount of the copper salt, whereas in more dilute solutions evaporation of water causes a more concentrated solution than that prepared at the outset. When the weaker stock solution is used, and some is carried over to the next period of spraying, a mark should be placed on the barrel in order that it can be restored to its original volume when required for use. Large quantities of copper sulphate are most easily and quickly dissolved by enclosing the crystals in a coarse sack—bran sack for example—and suspending them in the vessel of water, being careful to keep it near the surface.

The successful use of fungicides depends on other factors than simply the proper making of a spray mixture. The application of the fungicide should be thorough, which can only be assured when a pump is employed capable of maintaining a high pressure and provided with suitable nozzles for throwing a fine spray. Success or failure hinges also on the application or non-application of the fungicide at the proper time, or, as it may be expressed, the critical period. One application at the right time is more valuable than a dozen at the wrong time. "A stitch in time saves nine."

The secret of success in spraying for fungous diseases is that of exercising care in the preparation and application of the right fungicide at the right time and for the right purpose.

ETHERIZATION AS AN AID IN RHUBARB FORCING

The results of three years' investigation on the effect of subjecting plants such as lilacs to the fumes of ether, was announced to the Academy of Sciences at Copenhagen by Johannsen[1] in 1893. He found that by subjecting the lilac, when about to enter its resting period, to the fumes of ether for from 48 to 72 hours, it could be at once forced into bloom, whereas untreated plants could only be forced with difficulty if at all. These investigations paved the way for more extended work with the result that now the etherization of lilacs and many other hardy flowering plants of like nature is regarded as a necessary procedure in their early forcing. The recent agitation in the press with regard to rhubarb forcing, coupled with an abundance of suitable plants, suggested to the writer the possibility of applying the ether treatment to the dormant clumps.

The plants were dug up in late fall, placed in a cold frame and subjected to the action of frost in the usual way. Owing to delay in the construction of a suitable box, the trial did not begin until mid-December. The first lot consisted of eight as nearly uniform clumps as possible. These were placed in a cool cellar a few days to thaw out, after which they were divided into two lots, one of which was subjected to ether fumes for 48 hours on December 20, 1903. The etherization box was made as nearly air tight as possible, and contained nearly six cubic feet of air space. Sulphuric ether was used at the rate of 10 c. c. per cubic foot, no allowance being made for the space occupied by the clumps. The method of applying the ether was similar to that recommended by Johannsen and Maumene,[1] the liquid being poured through a small hole in the cover of the box into a vessel suspended beneath, the opening being at once stoppered. Immediately after 48 hours had elapsed the plants were removed from the box and with the untreated lot were at once set out under one of the greenhouse benches in a room having a night temperature of 45-50° F with a rise of 10-15° during the day. The light was excluded from the plants by means of drop curtains of black cambric.

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[1] Amer. Gardening 23, pp. 358-360, 372-3 (1900). (Trans. from an abstract by Fischer of a memoir by Dr. Johannsen).

Four separate lots in all were treated. The first, as mentioned, December 18-20, the second January 9-11, the third January 30-February 1, and the fourth, consisting of seven clumps, February 24-6. Similar treatment was accorded to all save lot III, which received a much stronger dose of ether, at the rate of 17 c. c. per cubic foot.

Cultural conditions.—All clumps were given as uniform cultural conditions as possible. Hence whatever variation occurred in the earliness of maturity of the stalks or in increased weight may reasonably be assumed to be due to the effects of etherization. The stalks were picked whenever they were considered mature enough and the number and weight picked from each lot recorded. As the particular object sought after was early maturity the results from the first three pickings are given separately in Table XX. The combined yields of all the pickings for the season are also given for each lot.

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[1] Maumene, Rev. Scientifique (1903); Abs. Public Opinion (1903); Flo. Review 12, pp. 964-5 (1903).

TABLE XX

AVERAGE NUMBER AND WEIGHT OF STALKS PER CLUMP FROM ETHERIZED AND NON-ETHERIZED LOTS

Number and treatment		Date when set	First picking			Second picking			Third picking			Total pickings			Percent total increase
			Date	No. stalks	W't grams	Date	No. stalks	W't grams	Date	No. stalks	W't grams	No.	No. stalks	W't grams	
I	Ether'd	Dec. 21	Jan. 29	7.	454.	Feb. 5	10.5	681.	Feb. 12	8.5	840.	6	47.5	2294.	34.4
	not “	Dec. 21	Jan. 29	8.	69.	Feb. 5	11.	246.	Feb. 12	9.	878.	6	37.5	1707.	
II	Ether'd	Jan. 11	Feb. 7	6.5	270.	Feb. 12	10.5	449.	Feb. 24	11.	608.	5	41.8	1914.	89.7
	not “	Jan. 11	....	....	....	Feb. 12	6.5	209.	Feb. 24	9.8	395.	5	26.8	1009.	
III	Ether'd	Feb. 1	Feb. 24	5.5	246.	Mar. 4	16.5	811.	Mar. 18	12.8	631.	5	35.8	1921.	26.8
	not “	Feb. 1	Feb. 24	9.8	410.	Mar. 4	16.5	775.	Mar. 18	13.8	720.	5	50.	2436.	
IV	Ether'd	Feb. 27	Mar. 18	.6	21.	Mar. 28	8.	348.	Apr. 6	5.	189.	3	13.6	553.	5.7
	not “	Feb. 27	Mar. 18	.6	34.	Mar. 28	7.	336.	Apr. 6	3.6	158.	6	11.2	523.	

Each of the first three pickings of lots I and II are with one exception (the third picking of lot I) decidedly in favor of the etherized clumps, not only in weight but in size of stalks as well. Lot III, which was treated with a very much stronger dose of ether, seemed to have been injured by the treatment, as in but one of the three pickings did it exceed that from the untreated. There is no marked difference in lot IV. This result confirms the observation made by Johannsen and, later, by others that there is little to be gained by etherization in the latter period of the resting stage. A comparison of the total yields shows a gain of 34.4, 89.7 and 5.7 percent in favor of the etherized clumps in lots I, II and IV respectively. In lot III the untreated plants give an increase of 26.8 percent.

Comparing the average yield of the first, second and third pickings from the four treated and untreated lots the following percentages of gain in favor of the etherized lots are obtained:

First picking	Etherized	250. grams.	Percentage gain 95.3
	Untreated..........	128. grams.	
Second picking	Etherized	571. grams.	Percentage gain 45.7
	Untreated..........	392. grams.	
Third picking	Etherized	442. grams	Percentage gain 7.3
	Untreated..........	412. grams.	
Three pickings combined	Etherized	1263. grams.	Percentage gain 35.5.
	Untreated..........	932. grams.	

The total average per clump from all pickings was as follows: Etherized clumps, 1671. grams; untreated clumps, 1419. grams; percentage gain for etherization, 17.7.

While these results are uniformly in favor of etherization, a much better showing might be made if those from lot III which, owing to its severer treatment is not strictly comparable, are discarded. A comparison made on this basis gives the following percentages of gain in favor of the etherized plants: First picking, 622 percent; second, 86 percent; third, 23 percent; fourth, 47 percent. The increase over the untreated plants is clearly emphasized in this comparison and forcibly illustrates the acceleration of growth due to this treatment. This is more especially true in the first and second pickings, in which the gains are 622 and 86 percents respectively. The accompanying illustration shows quite clearly the more rapid growth of the etherized plants, the photograph being taken before the first picking from these clumps was made.

The anesthetizing influence of ether or chloroform on plant life when in early or middle stages of dormancy seems to be in direct contrast to that upon animal life. Maumene (loc. cit.) suggests that it may be due "to acceleration of the order of growth" or "the suspension of an arrest which has occurred in the natural growth," or "it may be merely an excitant." Furthermore "the vapors of ether and chloroform only have a momentary effect, although they produce extreme stimulation, shorten the period of repose and inaugurate vegetation."

In summing up the results of the season's work it would seem quite evident that there was a decided impulse given to the ether treated dormant plants. This quickening of the vital processes in the plant resulted in a more vigorous growth and a decided increase in weight of product. From the data at hand it would seem reasonable to assume that even more satisfactory results might have been attained had the work been undertaken a month or six weeks earlier. It is probable also that etherization of the plants would serve the same purpose that freezing does, and in addition produce a greater growth.

REPORT OF THE CHEMISTS.

C. H. Jones and F. M. Hollister

The chief work of the chemists for the year includes the analyses of licensed commercial fertilizers (bulletins 107 and 108) and of commercial feeding stuffs (bulletins 101 and 104) as well as the analytical work contingent upon the feeding trials discussed under another head.

Nitrogen availability work has been continued, the chemist serving as referee on nitrogen for the Association of Official Agricultural Chemists.

Another proposition that has received more or less attention for several seasons past has been the detection of adulteration in maple syrup and sugar from the addition of commercial cane sugar.

A total of 4,020 samples have been analyzed during the year. They may be classified as follows: Milk (station herd) 2,150, milk and cream (from private individuals) 752, commercial fertilizers (official) 140, feeding stuffs (official) 340, maple syrup and sugar 40, coarse and fine feeds (feeding trials) 466, cattle feeds (from private individuals) 73, miscellaneous (from private individuals) 59.

The subject matter of the present report is presented under the following heads:

1. Detection of adulteration in maple sugar and syrup.
2. Miscellaneous analyses.

DETECTION OF ADULTERATION IN MAPLE SUGAR AND SYRUP.

By C. H. Jones

The problem of the detection of cane sugar when added to pure maple products has been studied as time permitted for three years past, and a large number of samples of maple sugar and syrup, both pure and adulterated, have been examined. No attempt will be made at this time to record all the results obtained, yet so many inquiries have been received regarding methods of detecting adulteration that it seems desirable briefly to summarize the work and to outline the methods employed.[1]

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[1] An early bulletin of this Station, No. 26, treats of maple sugar manufacture, while a recent one, No. 103, deals with the physiological and chemical phases of the maple sap flow.

Reliable data touching the analysis of maple goods of known genuineness are, so far as the writer knows, strangely lacking. Numerous analyses of commercial products of unknown origin are in hand but they are in the main confined to percentages of sucrose, reducing sugars and moisture, and aside from the occasional detection of glucose as an adulterant the chemical identity of the sugars derived from maple, cane, beet, etc., has been deemed sufficient to bar any attempt to differentiate between them. It is along other lines, however, that the adulteration of maple goods is to be detected. Maple sugar is a crude product which from the nature of the case is impracticable to refine. Neither is such refining desirable, for the peculiar value of maple goods is due, not to their sugar content or sweetness, but rather to the agreeable "maple flavor" that accompanies them. Too much refining eliminates this flavor and then the value of the goods is no greater than that of ordinary granulated or brown sugar.

Pure maple products and those adulterated with cane sugar seem most clearly differentiated by the varying amounts and nature of their ash contents. Only a trace of ash is found in refined cane sugar, while in maple sugar a much larger quantity is normally present. Commercial brown sugar may also carry a considerable ash content, but its character is so distinct from that found in the maple that mere similarity in amount of ash does not seriously interfere with its detection.

The examination of a large number of samples of known purity obtained in different seasons and from different localities justifies the statement that the ash of pure maple goods does not fall below 0.50 percent. This figure applies without qualification to syrups weighing 11 pounds to the gallon. The minimum figure for maple sugar is nearer 0.60 percent, owing to the less complete removal of the malate of lime ("sugar sand," "nitre"). These minimum figures are rarely attained, even when pure samples have been subjected to a filtration far more thorough than factory equipment affords (see page 453).

The appearance of the ash of pure maple goods is apt to be characteristic. The writer has repeatedly observed that white (refined) and brown sugars require much longer heating for complete incineration than do maple goods; that in many cases it is very hard to get rid of the last traces of carbon; and that the resulting ash is of a granular character. Pure maple products, on the other hand, burn much more readily to a white or gray ash which is usually of a leafy, network structure. Again the water-soluble-ash solution of the latter may exhibit, even after filtration, a pronounced cloudiness not cleared by the addition of hydrochloric acid. This has never been noticed when analyzing brown sugar or maple goods heavily adulterated with white sugar.

The scheme now in use in this laboratory for the ash analysis of maple products has been adopted as a result of much study on this matter, and may be briefly stated as follows:

Weigh 5 grams of sugar or syrup into a tared platinum dish; heat over asbestos board until thoroughly carbonized; transfer to a muffle and burn at low red heat to a white or gray ash. Cool in dessicator and weigh quickly.

Dissolve residue in about 40 c. c. hot water and boil gently for two minutes, using care to avoid spattering. Filter through a small ashless filter and wash with hot water until the filtrate amounts to about 100 c. c. Transfer filter and contents to the original platinum dish and incinerate at low red heat as before. Cool and weigh. Cool and titre the solution containing the soluble ash with tenth normal HCl, using methyl orange as indicator. Add to the insoluble ash an excess of the tenth normal acid (10 c. c. is usually sufficient) and about 30 c. c. water. Boil gently until solution is complete. Cool and titre with tenth normal sodium hydrate, using methyl orange as indicator.

Calculate from results thus obtained percents of total ash, water soluble ash, insoluble ash, and the alkalinity of the soluble and insoluble ash expressed in terms of cubic centimeters of tenth normal hydrocloric acid on a basis of 5 grams material.

The analyses displayed in Tables I-V show the ash contents with sundry subsidiary data of pure and adulterated maple sugars and syrups, together with the results obtained from an examination of commercial brown sugar and sundry other products. They have been selected from a large assortment of results and it is believed fairly represent good, medium and poor grade samples.

TABLE I. PURE MAPLE SUGAR

Character of goods	Medium, 1904 Early	Medium, 1904 Late	Light, 1904 Middle	Light, 1904 Early	Medium, 1904 Middle	Light, 1902	Light, 1902	Dark, 1903 Late
Sample number	1	4	8	14	22	32	33	36
1. Total ash, percent	0.87	1.01	0.76	0.70	0.94	0.90	0.64	1.32
2. Soluble ash, percent	0.51	0.51	0.42	0.36	0.42	0.60	0.44	0.45
3. Insoluble ash, percent	0.36	0.50	0.34	0.34	0.52	0.30	0.20	0.87
4. Ratio, insoluble to soluble ash 1:	1.4	1.0	1.2	1.1	0.8	2.0	2.2	0.5
5. Total alkalinity, 5 grams material	5.80	8.50	6.20	5.85	7.70	7.10	4.75	10.80
6. Alkalinity of soluble ash, 5 grams material	2.80	3.70	2.20	2.60	2.80	3.30	2.00	2.20
7. Alkalinity of insoluble ash 5 grams material	3.00	4.80	4.00	3.25	4.90	3.80	2.75	8.60
8. Alkalinity of 1 gram soluble ash	110	145	105	144	133	110	91	98
9. Alkalinity of 1 gram insoluble ash	166	192	235	191	188	253	275	198
10. Ratio, 1 gram soluble to 1 gram insoluble, alkalinity 1:	1.5	1.3	2.2	1.3	1.4	2.3	3.0	2.0
11. Percentage of ash, soluble	59	50	55	51	45	67	69	34

Total ash varies from 0.64 to 1.32 percent. The former, No. 33, was a remarkably pure sample, the syrup from which it was made having been carefully purified. The latter, No. 36, was about as rank a specimen of last run tub sugar as could be found. These two samples also furnish the minimum and maximum percentage for the insoluble ash, the low figure of the former, 0.20 percent, being due to the relative lack, and the high figure of the latter, 0.87 percent, to the abundance of crude malate of lime. The average proportion of ash that is soluble in water is 54 percent with extremes of 34 and 69 percents.

It is recognized that in most cases the removal of malate of lime or other sediment is more thoroughly done in syrup making than in sugar making, for the reason that it is noticeable and, therefore, objectionable in the former while it passes unnoticed in the latter. This being true, it follows that similar differences should appear in the ash of maple syrup.

TABLE II. PURE MAPLE SYRUP

Character of goods	Medium, 1904 Middle	Light, 1904 Early	Light, 1904 Early	Light, 1904 Middle	Light, 1904	Medium, 1904	Medium, 1904	Medium, 1904
Sample number	98	94	99	97	71	66	72	69
1. Total ash, percent	0.68	0.52	0.64	0.54	0.61	0.63	0.65	0.73
2. Soluble ash, percent	0.32	0.30	0.42	0.38	0.43	0.44	0.40	0.47
3. Insoluble ash, percent	0.36	0.22	0.22	0.16	0.18	0.19	0.25	0.26
4. Ratio, insoluble to soluble ash 1:	0.9	1.4	1.9	2.4	2.4	2.3	1.6	1.8
5. Total alkalinity, 5 grams material	6.85	5.00	5.80	5.00	4.25	5.25	5.15	5.20
6. Alkalinity of soluble ash, 5 grams material	2.65	2.40	3.20	2.65	1.95	2.40	2.45	2.40
7. Alkalinity of insoluble ash 5 grams material	4.20	2.60	2.60	2.35	2.30	2.85	2.70	2.80
8. Alkalinity of 1 gram soluble ash	166	160	152	139	91	109	123	102
9. Alkalinity of 1 gram insoluble ash	233	236	236	294	256	300	216	215
10. Ratio, 1 gram soluble to 1 gram insoluble, alkalinity 1:	1.4	1.5	1.6	2.1	2.8	2.8	1.8	2.1
11. Percentage of ash, soluble	47	58	66	70	71	70	62	64

The total ash of maple syrup shows less variation between samples than do the sugars (Table I). This is mainly due to the fact that impurities in the syrup were allowed to thoroughly settle out before samples were taken. Total ash varies from 0.52 to 0.73 percent and insoluble ash from 0.16 to 0.36 percent, while an average of 63 percent of the total ash is water-soluble. While it is possible to find plenty of pure maple syrup that will exceed these maximum figures for total and insoluble ash, the writer has yet to find a known pure sample carrying less than 0.50 percent total and 0.15 percent insoluble ash and showing the characteristic alkalinity.

TABLE III. ADULTERATED MAPLE SUGAR AND SYRUP.

Character of goods	Sugar, 1903 Medium	Sugar, 1904 Light	Sugar, 1903 Medium	Sugar, 1903 Light	Sugar, 1904 Medium	Syrup, 1903 Light	Syrup, 1903 Medium	Syrup, 1904 Medium
Sample number	83	84	74	75	79	85	86	87
1. Total ash, percent	0.42	0.25	0.24	0.16	0.48	0.49	0.31	0.26
2. Soluble ash, percent	0.20	0.19	0.13	0.10	0.34	0.36	0.20	0.16
3. Insoluble ash, percent	0.22	0.06	0.11	0.06	0.14	0.13	0.11	0.10
4. Ratio, insoluble to soluble ash 1:	0.9	3.1	1.2	1.7	2.4	2.8	1.8	1.6
5. Total alkalinity, 5 grams material	3.70	2.20	1.60	0.80	2.90	3.60	3.15	2.70
6. Alkalinity of soluble ash, 5 grams material	1.60	1.30	0.30	0.20	1.50	1.70	1.35	1.35
7. Alkalinity of insoluble ash 5 grams material	2.10	0.90	1.30	0.60	1.40	1.90	1.80	1.35
8. Alkalinity of 1 gram soluble ash	160	137	46	40	88	94	135	169
9. Alkalinity of 1 gram insoluble ash	191	300	236	200	200	292	327	270
10. Ratio, 1 gram soluble to 1 gram insoluble, alkalinity 1:	1.2	2.2	5.1	5.	2.3	3.1	2.4	1.6
11. Percentage of ash, soluble.	48	76	54	63	71	74	65	62

All of these samples with the possible exception of No. 75, although seriously adulterated with white sugar (refined, granulated), were well calculated, both in appearance and flavor, to pass the usual test of eye and taste and would have shown, had they been tested, not abnormal percentages of sucrose and reducing sugars. The total ash varies from 0.16 percent to 0.49 percent and the insoluble ash from 0.06 percent to 0.22 percent, the variations being necessarily due to the amount of the adulterant used and the character of the maple product adulterated. The soluble and insoluble ash alkalinities are also low.

When refined cane sugar is used as the adulterant it acts on the ash of maple goods simply as a dilutant, the amount and alkalinity of the mixed product being diminished. On the other hand, when cane or beet sugar containing appreciable amounts of ash are used, other factors than mere total ash must be considered, and it was with this point in mind that the scheme of ash analysis presented on page 448 was formulated.

TABLE IV. MISCELLANEOUS COMMERCIAL SAMPLES OF DIFFERENT GRADES OF BROWN SUGAR, RAW CANE SUGAR AND GLUCOSE[1]

Character of goods	Brown Sugar Dark	Brown Sugar Light	Brown Sugar Light	Brown Sugar Medium	Brown Sugar Light	Raw Cane Sugar N. Orleans	Karo*	Confectioners' Glucose
Sample number	89	90	92	91	100	98	95	96
1. Total ash, percent	4.33	1.44	1.06	2.80	0.74	0.59	1.03	0.57
2. Soluble ash, percent	2.74	1.30	1.00	2.15	0.68	0.41	0.86	0.45
3. Insoluble ash, percent	1.59	0.14	0.06	0.65	0.06	0.18	0.17	0.12
4. Ratio, insoluble to soluble ash 1:	1.7	9.3	16.7	3.3	11.3	2.3	5.	3.8
5. Total alkalinity, 5 grams material	15.50	3.70	2.30	6.65	2.15	3.90	4.00	2.10
6. Alkalinity of soluble ash, 5 grams material	3.80	2.40	1.50	0.75	1.30	1.60	2.00	1.20
7. Alkalinity of insoluble ash, 5 grams material	11.70	1.30	0.80	5.90	0.75	2.30	2.00	0.90
8. Alkalinity of 1 gram soluble ash	28	37	30	7	38	78	47	53
9. Alkalinity of 1 gram insoluble ash	147	185	267	182	250	256	235	150
10. Ratio, 1 gram soluble to 1 gram insoluble, alkalinity 1:	5.3	5.	9.	2.6	6.2	3.3	5.	3.
11. Percentage of ash, soluble	63	90	94	77	92	70	84	79

A comparison of these results with those already given shows marked differences to exist. A much larger proportion of the ash of brown sugar is water-soluble (see lines 4 and 11) than is the case with pure maple goods. The alkalinity of the soluble ash is very low, considering the amount present. This is probably due in a large measure to the increased quantity of sulphates present in this class of materials. This decreased alkalinity is strikingly brought out on line 8 of the table, where the results are calculated on a basis of 1 gram soluble ash, and again on line 10.

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* A commercial product said to contain 85% corn syrup (glucose), 15% cane syrup.

[1] Glucose can be detected by other methods than ash analysis and the results are simply given as a matter of interest.

TABLE V. MISCELLANEOUS PURE MAPLE PRODUCTS.

Character of goods	Penn. Stirred Sugar	Drained Maple Sugar	Drainings from No. 50	Drained Maple Sugar	Drained Maple Sugar	Maple Sugar	No. 19 Boiled and Filt'd	Filtered Syrup
Sample number	48	50	51	54	58	19	60	62
1. Total ash, percent	1.34	1.41	1.11	0.74	0.86	0.80	0.56	0.60
2. Soluble ash, percent	0.69	0.23	0.55	0.44	0.26	0.46	0.34	0.38
3. Insoluble ash, percent	0.65	1.18	0.56	0.30	0.60	0.34	0.22	0.22
4. Ratio, insoluble to soluble ash 1:	1.1	0.2	1.0	1.5	0.4	1.4	1.6	1.7
5. Total alkalinity, 5 grams material	10.10	9.85	9.90	6.55	7.10	6.65	6.20	5.40
6. Alkalinity of soluble ash, 5 grams material	3.70	1.20	3.55	2.30	1.30	2.80	2.90	2.90
7. Alkalinity of insoluble ash, 5 grams material	6.40	8.65	6.35	4.25	5.80	3.85	3.30	2.50
8. Alkalinity of 1 gram soluble ash	107	104	129	105	100	122	171	153
9. Alkalinity of 1 gram insoluble ash	197	147	227	283	193	226	300	227
10. Ratio, 1 gram soluble to 1 gram insoluble, alkalinity 1:	1.8	1.4	1.8	2.7	1.9	1.9	1.8	1.5
11. Percentage of ash, soluble.	52	16	50	59	30	58	61	63

Stirred sugar.—In the manufacture of this material syrup is thoroughly boiled, poured into suitable vessels and stirred by paddles until a dry, crumbly sugar results. Stirred sugar often resembles some of the grades of commercial brown sugar, although the taste reveals a strong and somewhat rank maple flavor. It usually shows a rather high total and insoluble ash content and contains about 5 percent or less of water.

Drained sugar.—A large part of the maple sugar made on the farm is run into wooden tubs and sold to the wholesaler in this form. The syrup from which it is made is often not boiled down even to 238° F. and as a result the sugar drains more or less on standing. Thus the upper portion of a tub may be very light in color, firm and dry, while the lower portion is several shades darker and quite moist. The analyses of samples 50, 51 and 58 in Table V show the effect of such conditions. The low soluble ash is characteristic of the drained portion, while with the drainings and lower portion the soluble ash shows a decided increase.

EFFECT OF FILTRATION

No. 19 (Table V) is a medium grade, dark colored sugar. It was dissolved in water, the syrup boiled to a density of 11 pounds per gallon (219° F.) and filtered through four sheets S. & S. filter paper No.

597. The ash analysis of the filtrate is given as No. 60. In spite of this treatment, which resulted in a far more thorough separation of impurities than any factory or farm maker could secure, the ash percentage is well above the minimum. The point particularly to be emphasized, however, is that the insoluble ash (0.22 percent) is well above the minimum allowable on pure goods (page 450). In other words, even slow and complete filtering, to which this sample was subjected, fails to remove sufficient ash from pure goods to allow of even a suspicion of adulteration according to the established standard.[1]

CENTRIFUGAL METHOD OF CANE SUGAR DETECTION

A short cut method has been used by us for some time quickly to sort out samples that have been seriously adulterated with refined sugar. It is based upon the volume of the precipitate produced in the sugar solution by lead subacetate.[2]

Method.—Five grams of sugar or syrup are weighed into a small beaker, dissolved in 10 c. c. of water and transferred to a Purdy sediment tube; 2 c. c. of standard lead subacetate solution are added, the solution mixed and the tube, placed in a perforated cork, is whirled in an ordinary Babcock machine for four minutes at a speed of 1,400 revolutions per minute. The volume of the precipitate is now read on the graduated scale.

The reading in pure maple goods of average quality will vary from 1.5 to 3 c. c. High grade syrups that have been carefully filtered show a reading which is rarely less than 1.2 c. c., while dark colored and rank sugars containing large amounts of malate may give a reading of over 5 c. c. Cane sugar naturally gives but a trace of a precipitate. Such samples adulterated with cane sugar as have been thus far examined show readings from 0.1 to 1 c. c. Samples showing a reading of 1 c. c. may be regarded with suspicion; if below that figure they are surely adulterated. On the other hand, samples reading over 1 c. c. are not necessarily pure. The method has its limitations, but if these are thoroughly understood the process is of great value, particularly if doubtful cases are subjected to a more complete chemical analysis. The method as above outlined has been used successfully by two large buyers of pure maple goods and has enabled them to detect several cases of adulteration and to reject the goods.

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[1] The bulk of the pure (in fact as well as name) maple syrup put on the market by supply houses is made by dissolving, boiling and filtering maple sugar. Hence commercial samples of pure maple syrup are apt to show ash contents more nearly approximating the minimum figures than will equally pure (i. e. genuine) samples made on the farm, because of the more thorough removal of impurities by the manufacturer.

[2] A similar test has been more perfectly worked out by Hortvet, U. S. Dept. Agr., Bureau Chem. Circ. (1904).

AROMA

The odor of maple products is at once pleasing and characteristic. That it is due to some partially volatile principle the odor of boiling sap or syrup makes plain. This aroma is at its best when the goods are fresh. It is so apt to be "bound up" in old and dry samples as to be apparently lacking. The writer has found it helpful when dealing with samples of this character or with commercial products of unknown origin to "bring out," so to speak, the true maple odor, if present, by the following procedure:

Twenty grams weighed into a 4 ounce beaker and dissolved in from 20 to 40 c. c. of hot water, are placed on an asbestos board and boiled. The amount of water to be added varies with the sample, but as carried out here if the mixture boils at 215°F.[1] the desired consistency has been obtained. After a few minutes' boiling, with occasional stirring, the odor is noted, either while still boiling or *immediately* after removal from the heat. Parties familiar with the true maple aroma—chemists and non-chemists alike—have been thus able correctly to distinguish the pure from the adulterated goods, though possessing no previous knowledge of the samples upon which they were called to pass.

No claim is made that this test in itself should serve either to condemn or to pass goods, but the result considered in connection with other analytical data possesses value. When suspicious commercial samples, particularly sugars, are in hand the above operation may be continued until the syrup boils at 219° or 220° F. If then removed and filtered while hot through double filter papers and the ash determined from 5 grams of the filtrate, the sugar, if pure, will furnish results which will be similar to those obtained from high grade syrups (see Table II, Nos. 94 and 97, and Table V, Nos. 60 and 62).

This may perhaps be more forcibly illustrated by stating the results obtained on a commercial sample sent to the writer for examination as to its purity:

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[1] See Vt. Sta. Rpt. 5, p. 160 (1891) for effect of altitude on boiling point. The Vermont station building is located about 350 feet above sea level.

	Original sample	Same after boiling and filtering
Percent of total ash	1.28	0.51
Percent of soluble ash	0.26	0.33
Percent of insoluble ash	1.02	0.18
Soluble ash, alkalinity c. c.	1.20	1.80
Insoluble ash, alkalinity c. c.	7.70	1.95

The sample was evidently pure maple sugar which had been exhaustively drained. Boiling and filtering served to remove the excess of malate of lime and a good grade of syrup resulted.

COLOR

The color of maple products is no indication of purity. Pure goods may be almost snow white, or they may be nearly jet black or any intermediate shade of brown. The color of pure goods is largely dependent on the methods used in handling and boiling the sap. The careless operator, even with the best utensils, will produce a poor grade, highly colored syrup or sugar. On the other hand, his cleanly and careful neighbor will make a first grade material. The reasons for this condition are well understood and explanations are unnecessary. As a rule first quality sugar brings a cent or two a pound at wholesale more than the second grade. On the other hand there is a ready market for pure goods, regardless of color; so it remains with the individual producer to decide what quality he will make.

LIME AND POTASH RATIOS

The complete analysis of the ash of pure maple goods shows it to consist largely of carbonates of lime and potassium with relatively small amounts of magnesium, sodium and silica. Manganese is also a normal constituent. Sulphates and phosphates are present in small quantities. Indeed the amount of the former may be of use in detecting adulteration, since sulphates are present in relatively large amounts in commercial brown and cane sugars.

The amount of lime (CaO) and potash ($K^{2}O$) may afford data useful in judging the purity of suspected samples. Gravimetric determinations of these constituents in the ash of maple goods of known purity give results as follows:

No.		% CaO	% $K^{2}O$	% SO^{3}	Ratio CaO to $K^{2}O$
1.	Maple sugar	0.220	0.244	0.023	1 :1. 1
2.	Maple sugar	0.419	0.241	0.022	1 :0.57
3.	Maple sugar	0.168	0.212	0.011	1 :1.26
4.	Maple sugar	0.164	0.257	0.013	1 :1.53
5.	Maple syrup	0.110	0.195	0.014	1 :1.77
6.	Maple syrup	0.136	0.204	0.013	1 :1.50
7.	Brown sugar (light)	0.06	0.57	0.07	1 :9. 5
8.	Brown sugar (dark)	0.49	1.33	0.77	1 :2. 7
9.	Brown sugar (light)	0.16	0.41	0.044	1 :2. 5

The column of ratios is particularly suggestive. Sample No. 2, showing a ratio of lime to potash of 1:0.57, is the rank poor grade material reported in Table I as No. 36. It shows one extreme. The other analyses are from far better grade goods and run from 1.1 to 1.53. The two maple syrups examined show slightly higher ratios, 1:1.5 and 1:1.77, due to the more thorough removal of lime impurities. The brown sugars without exception show greatly increased ratios; and it is probably true that refined sugar would show similar increases due to the greater proportion of potash and soda normally present.

Sufficient data has not yet been accumulated to warrant deductions regarding the sulphate (SO^3) content. The amount present, however, in the brown sugars thus far examined is far in excess of that observed in pure maple goods.

This report is simply one of progress. Further work along these lines is now in hand, as is also work leading to the examination of organic acids normally present in pure maple products, the results of which will doubtless appear in future reports.

MISCELLANEOUS ANALYSES

Section 263 of the Vermont Statutes requires the Station to analyze free of charge miscellaneous materials of an agricultural nature for residents of the State. Those deemed of sufficient interest to place on permanent record are here recorded:

MATERIALS FURNISHING NITROGEN

Material	From	Percent nitrogen
Nitrate of soda	Newport	15.93
Nitrate of soda	So. Barre	15.72
Nitrate of soda	Plainfield	15.92
Nitrate of soda	Castleton	15.72

MATERIALS FURNISHING NITROGEN AND PHOSPHORIC ACID

Material	From	Percent of nitrogen	Percent of phosphoric acid
Tankage	Castleton	9.91	4.60
Fish scrap	West Brattleboro	8.75	8.87
Fine ground bone	Newport	2.98	20.68
Ground bone	Lyndon	2.35	18.20
Raw bone meal	Fairlee	3.30	24.80
Crescent bone dust	Wilder	2.88	13.32

MATERIALS FURNISHING AVAILABLE PHOSPHORIC ACID

Material	From	Phosphoric acid Soluble %	Phosphoric acid Reverted %	Phosphoric acid Insoluble %	Phosphoric acid Total %	Phosphoric acid Available %
Acid phosphate	West Brattleboro	.....	....	1.85	17.36	15.51
Acid phosphate	So. Barre	10.40	4.96	1.60	16.96	15.36
Acid phosphate	Castleton	9.12	4.93	2.01	16.06	14.05
Acid phosphate	Lyndon	15.67	1.21	0.42	17.30	16.88

MATERIALS FURNISHING POTASH

Material	From	Percent of potash
Muriate of potash	Newport	50.30
Muriate of potash	Castleton	52.50
Muriate of potash	Plainfield	51.10
Sulphate of potash	So. Barre	48.80
Sulphate of potash	W. Brattleboro	53.35
Sulphate of potash	Lyndon	53.50

WOOD ASHES

No.	From	Soluble potash %	Insoluble potash %	Total potash %	Total phosphoric acid %	Calcium oxide %	Insoluble matter %
1.	J. J. Ross, Huntington	1.89	1.70	3.59	1.66	20.51	24.00
2.	J. J. Ross, Huntington	1.98	2.76	4.74	1.98	27.25	21.45
3.	J. O. Sanford, Stamford	3.86	2.00	5.86	2.54	30.65	18.79
4.	F. G. Helyar, Brattleboro	5.88	1.06	6.94	2.97	31.02	11.53
5.	F. G. Helyar, Brattleboro	4.28	1.40	5.68	2.55	21.54	33.03
6.	A. A. Dunklee, So. Vernon	4.23	0.85	5.08	2.28	26.36	20.85
7.	A. A. Dunklee, So. Vernon	3.04	0.80	3.84	1.44	26.28	23.00
8.	A. A. Dunklee, So. Vernon	5.13	0.25	5.38	1.52	27.68	6.48
9.	A. A. Dunklee, So. Vernon	3.44	0.30	3.74	1.40	23.40	17.40
10.	Mrs. S. O. Wiley, Chester	5.40	0.58	5.98	1.56	31.22	10.75
11.	J. E. Leach, Westminster	4.00	0.67	4.67	1.21	36.27	12.00
12.	J. B. Adams, Randolph Ctr. (purch.)	3.25	1.90	5.15	1.59	31.99	22.20
13.	J. B. Adams, " (home-made)	6.76	0.35	7.11	1.91	28.77	14.90
14.	Brandon Lime & Marble Co., Leicester Junction	5.93	1.04	6.97	2.04	41.24	1.70
15.	E. S. Brigham, St. Albans	2.26	0.20	2.46	1.36	40.86	1.36

Samples 1 and 2 were represented to be softwood ashes and were partially leached. Nos. 14 and 15 were lime kiln ashes. We are unable to explain the large soluble potash content of No. 14. It should be remembered, however, that the Station assumes no responsibility as to the nature or authenticity of the samples taken by parties other than their authorized sampling agents. Ashes are mainly valuable, aside from their mechanical and biological influence, for the water-soluble potash content. This ranges in the samples reported from 1.89 to 6.76 percent, and again emphasizes the oft-repeated caution, "buy ashes only on their merits as shown by experiment station analysis."

FERTILIZERS AND HOME MIXTURES

From	Nitrogen %	Soluble phosphoric acid %	Reverted phosphoric acid %	Insoluble phosphoric acid %	Total phosphoric acid %	Available phosphoric acid %	Potash %
Geo. Aitken, Woodstock....	2.00	3.16	5.14	4.00	12.30	8.30	6.46
Geo. Aitken, Woodstock....	3.02	2.74	5.27	2.75	10.76	8.01	6.22
F. H. Hawley, W. Rupert..	3.82	....	....	7.75	22.46	14.71	3.65
Exp. Farm, Burlington.....	3.11	....	....	7.15	20.35	13.20	4.04

The first two samples were home mixtures, while the latter two were Peruvian Guano, sold by E. Mortimer & Co. of New York city. All were in an excellent mechanical condition.

MUCK

From	In original substance				In dry matter		
	Water %	Ash %	Organic and volatile matter %	Nitrogen %	Ash %	Organic and volatile matter %	Nitrogen %
E. B. Sawyer, Hyde Park..	87.91	6.26	5.83	0.204	51.78	48.22	1.69
H. A. Parmeley, Milton....	72.55	17.72	9.73	0.44	64.55	35.45	1.59
Geo. Stokes, Starksboro....	67.08	18.30	14.62	0.54	55.58	44.42	1.65
G. B. Miles, Monkton Ridge	.....	.....	.....	.....	73.25	26.75	0.91

The first three samples reported are of a fair grade only, as they contain altogether too much ash to make their use profitable except, perhaps, under the most favorable conditions of location. The last sample was full of small shells and was termed "shell muck." It contained 27.39 percent of lime, largely as carbonates. Its use as a source of lime for hens has been suggested.

The Station is about to undertake an investigation relating to the extent and nature of the muck deposits in Vermont and more extended data may be looked for in future reports.

SILAGE, ETC.

Material	From	Water %	Crude ash %	Crude protein %	Crude fiber %	Nitrogen-free extract %	Ether extract %
Barley and weed silage	C. F. Smith, Morrisville.	79.23	2.34	2.41	7.50	7.91	0.61
Oats and pea silage	C. F. Smith, Morrisville.	80.38	1.83	1.90	8.03	7.16	0.70
Foul seed	A. D. Horskin, Franklin.	13.22	10.46	11.19	13.97	46.72	4.44

The silage samples, while making a good showing chemically, were dark colored and of a most rank and objectionable odor. The silage from which the above samples were taken was, however, successfully fed. Numerous unground seeds were present in the foul seed sample, and these, after passing unchanged through the animal into the manure, are liable to contaminate the land with objectionable weeds.

	Bone and lime	Dry waste	Greasy waste
Organic and volatile	33.60%	50.52%	75.51%
Ash	66.40	49.48	24.49
Nitrogen	0.98	2.74	3.79
Phosphoric acid (total)	12.78	0.28	0.28
Phosphoric acid (available)	11.35	.....	.....
Calcium oxide (lime)	29.82	.....	.....
Potash	.....	0.22	0.18
Insoluble matter	1.50	37.76	18.98

The bone and lime mixture was a refuse material from a manufacturing industry. It gave a slight acid reaction and carried 34.56 percent of sulphate of lime. At the price asked we did not consider it a desirable purchase as a substitute for the ordinary acid phosphate for fertilizing purposes.

The two samples of waste came from a woolen mill and appeared to be largely sweepings. The nitrogen present, while considerable in amount, is but slowly available. Properly applied to the right soil they would have some value as a source of nitrogen.

A sample of hen manure from Brattleboro contained nitrogen 2.07, potash 1.05, phosphoric acid 1.35 percent, insoluble matter 52.25. The high percentage of insoluble matter was due to the addition of sand to the manure on the floor of the hen house. As received it was in a good mechanical condition for use and its value as a fertilizer is apparent from the above figures.

A weed killer sold under the name of "Thistleine," manufactured by the Lindgrem Chemical Co. of Grand Rapids, Mich., was qualitatively examined and proved to be an arsenical preparation. The insoluble blue pigment present, which settles out on standing, was ultramarine and probably adds nothing to the value of the mixture as a weed destroyer.

Maple sugar.—A sample of maple sugar sent from Barton, Vt., contained sucrose 92.98 percent, reducing sugar 3.16 percent, ash 0.23 percent, water and undetermined 3.63 percent. It was pronounced heavily adulterated with cane sugar. Another sample, from Newport, Vt., testing total ash 1.06 percent, soluble ash 0.52 percent, insoluble ash 0.54 percent, lead subacetate precipitate 3.20 c. c., was reported pure.

DAIRY FEEDING

J. L. Hills

Vermont makes more butter than does any other State—in proportion to her area. More cows roam her fertile fields than elsewhere—according to her acreage of tillage, meadow and pasture. The average dairy herd is larger than in any other State, there being 80 cows for every 100 human beings and 5.5 cows to each person engaged in agriculture. Hence it naturally follows that from the outset this Station has made much of dairy experimentation; less than it might have done had not other interests demanded attention, or than could have been done with more ample means; yet much that has been worth doing. This work has been largely confined to dairy feeding, to trials as to their relative values of sundry roughages and concentrates, to critical studies into the validity of the current methods employed in such trials, to the maintenance of herd records and the like.

The matters which are at present in shape for publication are discussed under the following headings:

Feeding Trials with Cows.
    I. Introduction.
    II. Is a two pound grain ration fed daily enough?
    III. The feeding value of dried molasses beet pulp.
    IV. The feeding value of India wheat meal.
    V. The feeding value of hominy feed.
    VI. The experimental error inherent in the alternation method.
    VII. Summary.
A Comparison of Feeding Trial Methods (Fourth article).
Record of the Station Herd for 1903-1904.

FEEDING TRIALS WITH COWS

This article is summarized at its close, nearly 40 pages further on. The results of the trials are concisely stated therein and cross references given.

I. INTRODUCTION

The large size of the Station herd admits of much work being done in feeding experimentation, a wide range in choice of animals, much repetition, and the conduct at one time of a relatively large number of trials. For several years a dual purpose has been held in mind in the plan and execution of these trials, viz.: to add not only to our knowledge as to the relative values of sundry roughages and concentrates but also to test the trustworthiness of the methods used; and it is expected to pursue this line of work for some time in the future.

The experimental feeding of the winter of 1903-04 was directed at the solution of the following queries:

1. Is a two pound grain ration fed daily enough?
2. What is the feeding value of dried molasses beet pulp?
3. What is the feeding value of India wheat meal?
4. What is the feeding value of hominy feed?
5. What is the extent of the experimental error in the alternation system of feeding trials?

The records made by 53 cows during the six months' feeding trials are deemed safe to use as a basis for deductions. But little sickness interfered. The results in a few cases were impaired because of temporary illness, of early drying off, or because the animal went off feed. It is not strange that minor misfortunes occur when 53 cows were fed for from fifteen to twenty-five weeks under conditions involving radical changes in the character or quantity of their rations. No seriously disturbing factor common to the entire herd was noted.

The 53 cows whose records are available for use were distributed among the several tests as follows:

(a)	Very low, low and medium grain rations........	14
(b)	Dried molasses beet pulp vs. wheat bran........	6
(c)	Dried molasses beet pulp vs. silage..............	5
(d)	India wheat vs. wheat bran....................	6
(e)	India wheat vs. cottonseed and linseed meals.....	6
(f)	Hominy feed vs. wheat bran....................	6
(g)	Hominy feed vs. gluten meal..................	4
(h)	Hominy vs. cottonseed and linseed meals......	6
		53

All the cows were not equally suited to the purpose as regards time of lactation. A study of previous records—extending over nearly ten years with some animals—of ages, times of calving, flow and quality of milk, times of service, etc., prefaced choice. Preference in selection was on the whole given to trial (a).

DETAILS OF FEEDING

The general plan of the trials was the same as that hitherto in vogue at this Station and is outlined on pages 212-213 of the last report.

The changes in daily grain feed were as follows:

(a) *Very low, low and medium grain feed;* fourteen cows, continuous feeding on either mixed feeds Nos. 1 or 6, amounts varying either from 2 to 4 or from 2 to 8 pounds daily, or remaining constant throughout the trials at either 2 or 4 or 8 pounds daily.

(b) *Dried molasses beet pulp vs. wheat bran;* three cows fed feed mixtures Nos. 1 and 7 alternately, two cows fed No. 7 and one cow fed No. 1 continuously.

(c) *Dried molasses beet pulp vs. silage;* three cows fed silage and pulp alternately, two cows fed pulp continuously.

(d) *India wheat vs. wheat bran;* three cows fed Nos. 1 and 3 alternately, two cows fed No. 3 and one No. 1 continuously.

(e) *India wheat vs. cottonseed and linseed meals;* three cows fed Nos. 1 and 2 alternately, two cows fed No. 2 and one fed No. 1 continuously.

(f) *Hominy feed vs. wheat bran;* three cows fed Nos. 1 and 4 alternately, two cows fed No. 4 and one No. 1 continuously.

(g) *Hominy feed vs. gluten meal;* three cows fed Nos. 4 and 6 alternately, two cows fed No. 4 and one No. 6 continuously.

(h) *Hominy feed vs. cottonseed and linseed meals;* three cows fed Nos. 1 and 5 alternately, two cows fed No. 5 and one cow fed No. 1 continuously.

(i) The sundry cows fed continuously on one ration furnished data of service in the determination of the extent of *experimental error.*

The heifers were fed 6 pounds of grain daily, the other cows 8 pounds daily, unless otherwise stated.

WEIGHTS OF COWS

The cows were weighed daily on the first three days at the opening period and on the last three days of each period. Those fed the very low grain rations shrank heavily, and those fed low rations, somewhat. When cows thus treated were put upon the medium ration they naturally picked up again. Two of the three continuously fed a very low grain ration shrunk greatly, while the third gained in weight despite her handicap. The cows continuously fed the low ration about held their own.

Ten cows ate more or less beet pulp, four eating it daily for 25 weeks. Three of these four averaged to gain 85 pounds in live weight. The fourth lost 100 pounds in weight, not, however, on account of her ration. The other six gained on the average 20 pounds in weight when eating pulp and barely held their own when a limited silage ration was substituted therefor. It would seem that dried molasses beet pulp tends to fatten cows. No other material effect on live weight was discernable save a general tendency towards heavier weights as the trials advanced, a tendency which prolonged feeding in winter and spring has always shown, which is entirely natural and is to be expected.

BARN TEMPERATURES

The cows were stabled in two portions of the barn structure, the temperatures of which were taken daily at 5 A. M., 12 M., and 6 P. M. Its exposed location caused considerable fluctuation in the temperature of the cow stables during the winter, notwithstanding the many animals housed therein. The average temperatures, morning, noon and night, during each period, the range of variations, and the percent of the entire number of observations within 3° F. of the mean of each period are tabulated in the appendix.

The winter was a bitterly cold one and the barn temperatures averaged during the first three periods 6° F. lower than in the preceding winter, which was a normal one, dropping below 40° F. several times. On December 26-29 average barn temperatures were 44° (3° below normal); January 2-7, 43° (4° below normal); January 17-20, 43° (5° below normal); and February 9-13, 42° (6° below normal). The cows shrunk in yield during the first three cold spells an equivalent of 0.4 pounds of milk a day, and in the extreme cold of February 9-13, an equivalent of 0.7 pounds of milk daily. No such large shrinkages occurred at other times. Inasmuch, however, as the cows were at all times distributed among the various tests, it may be safely assumed that the effects were similarly distributed and, consequently, negligible in the final result, a conclusion based not only on the present year's trial but upon observations on the point for many years past. A more uniform barn temperature would have been desirable, but it was not essential.

PERIODS AND COWS

The following tables show the periods, dates, cows, and the nature of the grain feeds used. Italicized names are those of registered Ayrshires, the small capitals indicate registered Jerseys, and the names in ordinary type are those of high grade Jerseys.

The abbreviations in the table may be explained as follows: "Med." indicates that a medium 8 pound daily ration was fed to mature cows and a 6 pound one to heifers; "v. low," that a 2 pound daily grain ration was fed; and "low," that a 4 pound daily grain ration was used. The arabic numerals in the columns headed I to V refer to the feed mixtures, which were made up by weight of:

No. 1. Wheat bran, 4 parts; cottonseed meal, 1 part; linseed meal, 1 part.

No. 2. Wheat bran, 4 parts; India wheat, 2 parts.

No. 3. Wheat bran, 2 parts; cottonseed meal, 1 part; linseed meal, 1 part; India wheat, 2 parts.

No. 4. Wheat bran, 4 parts; hominy feed, 2 parts.

No. 5. Wheat bran, 2 parts; cottonseed meal, 1 part; linseed meal, 1 part; hominy feed, 2 parts.

No. 6. Wheat bran, 4 parts; gluten meal, 2 parts.

No. 7. Wheat bran, 2 parts; cottonseed meal, 1 part; linseed meal, 1 part; dried molasses beet pulp, 1 part.

COWS USED AND NATURE OF GRAIN RATIONS, ETC., FED DURING EACH PERIOD

Name	Approximate age Nov. 1, 1903	Calved 1903 or 1904	Served 1903 or 1904	Period numbers				
				I	II	III	IV	V
Low, very low and medium grain feeding								
Stella	6	Dec. 3	July 20	....	low	med.	low	med.
Eunice	6	Dec. 21	July 27	med.	med.	med.	med.	med.
Constance	4	March 1	Nov. 7	v. low	v. low	v. low	v. low	v. low
Beautina	12	June 15	*Apr. 19	v. low	med.	v. low	med.	....
Lady Perusia	10	Feb. 15, 04	....	....	....	v. low	v. low	v. low
Serena	7	Feb. 14, '04	June 30	....	....	v. low	med.	v. low
Minta Bella	12	May 7, '04	Nov. 25	med.	med.	med.	....	....
Judith	7	March 7	May 30	med.	v. low	med.	....	....
Lucerne	10	Nov. 10	Feb. 25	....	v. low	v. low	v. low	v. low
Yuba	5	Oct. 27	Feb. 12	....	v. low	low	v. low	low
Lavender	6	Aug. 4	Dec. 5	low	low	low	low	low
Ursula	7	Sept. 7	....	low	v. low	low	v. low	low
Elsa	6	Sept. 7	Feb. 1	....	low	low	low	low
Vivian	8	Aug. 6	Feb. 4	....	v. low	low	v. low	low
Beet pulp vs. bran								
Acme	14	Oct. 10	Feb. 15	7	7	7	7	7
Atalanta	14	Nov. 20	Mar. 2	7	1	7	1	7
Elizabeth	3	Nov. 4	Feb. 4	1	1	1	1	1
Santa Clara	5	July 23	....	1	7	1	7	1
Mona	6	Jan. 3, '04	July 26	....	1	7	1	7
Orpha	11	April 17	Sept. 19	7	7	7	....	....
Beet pulp vs. silage								
Alta	7	March	Oct. 30	pulp	pulp	pulp	pulp	pulp
Adelaide	10	Apr 13	Dec. 15	pulp	silage	pulp	silage	pulp
Nancy B	15	Aug. 7	Jan. 15	silage	pulp	silage	pulp	silage
Vt. Una	4	May 17	Jan. 19	pulp	silage	pulp	silage	pulp
Surprise	4	June 13	Nov. 16	pulp	pulp	pulp	pulp	pulp
India wheat vs. bran								
Sonoma	5	Jan. 15, '04	July 31		8	8	3	8
Ceres	13	Jan. 9, '04	July 28		8	1	3	1
Maid Marian	10	Jan. 2, '04	May 19		1	1	1	1
Rosemary	9	Jan. 15, 04	June 14		8	1	3	1
Max Belle	11	Nov. 4, '02	Jan. 26	8	3	8	3	8
Vt. Muriel	3	Dec. 21, '02	Nov. 10, '03		1	8	1	8
India wheat vs cottonseed and linseed meals								
Eva	11	June 15	Feb. 10	2	2	2	2	2
Mermaid	8	June 16	Nov. 8	2	1	2	1	2
Edith	6	Feb. 27	Oct. 2	1	1	1	....	....
Eleanor	5	March	May 1	1	2	1	2	1
Queenie	3	Feb. 27 '02	Aug. 20	2	2	2	....	....
Linnet	3	Jan. 28	May 22	2	1	2	1	2
Hominy feed vs. bran								
Flora	14	Oct. 3	March 4	4	4	4	4	4
Rosel	7	Aug. 26	Nov. 21	4	1	4	1	4
Juanita	6	Aug. 5	Aug. 15	1	1	1	1	1
Pomona	12	Dec. 22	Oct. 30	....	1	4	1	4
Mayfair	8	Jan. 11	Apr. 30	....	1	4	1	4
Hallowe'en	10	Dec. 25	Aug. 7	....	4	4	4	4
Hominy feed vs. gluten meal								
Inez	11	Dec. 28	March 20	....	6	4	6	4
Fresno	5	Nov. 8	March 17	4	6	4	6	4
Jersey Lily, 2nd	4	April 16	March 24	4	4	4	4	4
Starbright	7	*Sept. 20	....	4	6	4	6	4

Name	Approximate age Nov. 1, 1903	Calved 1903 or 1904	Served 1903 or 1904	Period numbers				
				I	II	III	IV	V
Hominy feed vs. cottonseed and linseed meals								
Stephanie......	7	March	Nov. 10	5	5	5	5	5
Lizzie Hexham.	4	March	Sept. 15	5	1	5	....	....
Santa Rosa....	5	Aug. 16	Jan. 29	1	1	1	1	1
Yemassee.......	9	March	Dec. 11	1	5	1	5	1
Janice..........	7	*July 30	Nov. 7	5	5	5	5	5
Haidee.........	7	Feb. 26	Sept. 5	5	1	5	....	....

*Aborted.

AVERAGE ANALYSES OF FODDERS AND FEEDS

Fodders and feeds	Original substance		Composition of dry matter							
	Water	Dry matter	Crude ash	Crude protein	Crude fiber	Nitrogen-free extract	Ether extract	Nitrogen	Phosphoric acid	Potash
Hay (main barn)	14.01	85.99	6.59	9.69	32.06	48.75	2.91	1.55	0.58	1.91
Hay (annex barn)	13.57	86.43	5.83	8.75	31.80	50.92	2.70	1.40	0.49	1.67
Oat hay,	14.18	85.82	8.87	11.44	33.02	44.53	2.14	1.83	0.83	3.38
Silage (immature),	78.45	21.55	6.41	8.62	26.06	56.69	2.22	1.38	0.74	1.86
Mixed feed,										
No. 1,	11.86	88.14	7.09	28.25	9.22	49.11	6.33	4.52	2.62	1.78
No. 2,	14.49	85.51	5.52	16.56	6.83	67.95	3.14	2.65	2.28	1.41
No. 3,	12.48	87.52	5.65	25.12	5.83	58.14	5.26	4.02	2.03	1.52
No. 4,	12.14	87.86	5.62	16.38	6.89	64.91	6.20	2.62	2.52	1.47
No. 5,	11.15	88.85	5.84	24.94	6.84	54.52	7.86	3.99	2.32	1.43
No. 6,	11.18	88.82	4.42	27.31	6.46	57.22	4.59	4.37	1.87	1.16
No. 7,	10.19	89.81	6.70	23.75	10.05	54.28	5.22	3.80	1.86	1.82
Wheat bran,	13.48	86.52	6.74	18.75	9.87	60.53	4.11	3.00	3.28	1.92
Cottonseed meal,	7.73	92.27	7.81	48.81	5.18	28.22	9.98	7.81	3.09	2.18
Lin. meal (O.P.)	10.78	89.22	6.24	34.56	8.73	42.93	7.54	5.53	1.55	1.39
Chi. gluten meal,	9.57	90.43	1.47	40.63	1.23	51.93	4.74	6.50	0.60	0.14
Hominy feed,	12.32	87.68	3.26	12.06	3.55	72.53	8.60	1.93	1.47	0.90
Molass. beet pulp,	7.05	92.95	6.72	10.50	16.09	66.15	0.54	1.68	0.29	1.77
India wheat,	17.31	82.69	3.65	14.25	3.01	77.31	1.78	2.28	1.25	0.86

AVERAGE DIGESTIBLE INGREDIENTS IN FODDERS AND FEEDS

Fodders and feeds	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract
Hay (main barn)	51.6	4.8	16.0	26.9	1.5
Hay (annex barn)	51.9	4.3	16.0	28.2	1.4
Oat hay	42.1	5.3	12.5	19.9	1.2
Silage (immature)	14.3	0.95	4.0	8.2	0.04
Molasses beet pulp	76.3	6.2	12.4	51.7	...
Mixed feed No. 1	59.0	20.1	3.2	31.6	4.2
" 2	55.4	11.1	1.6	39.9	2.0
" 3	61.2	18.3	2.0	35.1	3.8
" 4	62.1	11.3	2.4	44.8	3.9
" 5	67.3	18.4	2.9	39.7	5.6
" 6	62.6	19.8	1.7	38.5	2.9
" 7	66.6	17.3	5.9	37.2	3.7
Wheat bran	53.7	12.7	2.5	36.1	2.4
Cottonseed meal	68.3	39.6	2.7	15.9	8.6
Linseed meal (O. P.)	70.5	27.5	4.5	29.9	6.0
Chicago gluten meal	81.4	32.3	....	42.3	4.1
Hominy feed	78.9	8.2	2.6	60.5	6.2
India wheat	57.9	7.9	....	45.9	1.1

Experimental feeding work began December 4 and closed May 27. Every milking of each cow was weighed and sampled. Nine milking composites were analyzed for total solids and fat, using the Babcock, lactometer and the Richmond slide rule. The system in use as to sampling fodders and feeds, and as to control of the quality of hay fed was the same as that hitherto in use and outlined on pages 215-216 of the last report.

The hay was in general a good grade of early cut hay of mixed grasses, largely timothy, with a fair sprinkling of clover. Oat hay, however, was necessarily fed to some extent in the main barn during the first four periods. It was hoped that it would last for the full time, but it ran out sooner than was expected. The silage was made of immature Sanford corn, was fairly well kept and somewhat acid. Its quality and feeding value were impaired by immaturity. The grain feeds were with two exceptions standard materials of standard quality. Dried molasses beet pulp is a kiln dried residuum of the diffusion battery of beet sugar factories to which molasses is added. India wheat is the ground and bolted meal made of the seed of this small hardy variety of buckwheat, frequently grown in the more elevated regions of the State and used in lieu of common buckwheat.

The statements as to the volume of work involved in these trials, the methods in vogue for checking mathematical accuracy, etc., given on pages 216-217 of the last report, are equally pertinent here. The condensed data as usual appears in the appendix.[1] This is omitted in the general edition, since it comprises a mass of figures of interest solely to the student of animal husbandry and as a matter of record showing the basis for the conclusions drawn from these trials. Copies may be obtained on application by such parties as may desire it. It is printed in the edition sent to the Experiment station and library mailing lists. Only such tabular matter as is needed to explain the text is included in the body of the articles.

II. IS A TWO POUND GRAIN RATION FED DAILY ENOUGH?

The question as to the best amount of grain, viewed from the standpoint of profit as well as from the usefulness of the cow, has been in review at this Station for five years. The results obtained in the previous trials appear in former reports.[1] The issue of this fifth season's experience is shown in the context.

During the first three years the merits of low—4 pound—and of high—12 pound— grain rations were compared with those of medium—8 pound—feed. The outcome, speaking broadly, has not favored the heavier ration, which was fed at a loss. The 4 pound ration, however, quite often proved as good as, or, viewed from the money standpoint only, better than an 8 pound one, when early cut hay containing considerable clover, and well matured, well eared corn silage were fed in fairly liberal quantities. Last year for the first time a 2 pound daily grain ration was fed experimentally, and the trial has been repeated this year. While the writer felt that this amount of grain was too small, there were good dairymen preaching and practicing the doctrine of an extremely limited grain ration as an antidote to high prices for concentrates, claiming that when feeding more liberally they were not getting a dollar in milk for a dollar invested in grain. Hence it seemed wise to put the query to the cows. Twelve passed judgment on the proposition last year and 14 this year. The verdict handed up by the jury which tried the case in 1902-03 was that "it seems fair to conclude that in these trials the restriction of the grain ration to 2 pounds was made at the expense of the animals' well being and of the owner's pocketbook." There were, however, "extenuating circumstances" in the case, errors in feeding seriously curtailing data, poor silage, etc. Then, too, as was pointed out in the last report, "no one trial can settle this matter. The character, quality and quantity of the roughages used, and individuality of the cows, as well as that of the feeder, enter into the problem; in short, circumstances so markedly alter cases that the outcome of these trials or, if confirmed by further tests, of several trials, would not necessarily be duplicated elsewhere by other feeders. The results of these trials then simply afford so much testimony as to the advisability of feeding very low grain rations, testimony which may or may not be confirmed by other witnesses." The present trial therefore merely records the verdict of another lot of cows in another season with other rations, and does not settle the matter. It is not expected, however, to pursue it further at this Station at the present, save to note carefully what might be termed the residual effects of low feeding on the after dairy life of the cows.

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[1] APPENDIX CONTAINING CONDENSED DATA PERTAINING TO ARTICLES ON FEEDING TRIALS WITH COWS

I. Weights of cows.
II. Average barn temperatures, with ranges and percentages of uniformity.
III. Analyses and digestible ingredients in fodders and feeds; (*a*) analyses on dry basis; (*b*) digestion co-efficients; (*c*) pounds of digestible nutrients in 100 pounds of original substance.
IV. Feeding records of the individual cows in feeding tests.
V. Production records; showing production and same per unit for each individual cow in feeding tests.
VI. Difference tables. (*a*) Totals of differences; (*b*) Percentage differences.
VII. Results of experimental feeding on different rations.

[1] Vt. Sta. Rpts. 13, pp. 402-417 (1900); 14, pp. 325-340 (1901); 15, pp. 280-300 (1902); 16, pp. 221-237 (1903).

FEEDING

It seemed best to feed two different grain rations (differing not only as between themselves, but from what were used the previous year); to use two methods of measurement, the alternation and the combined continuous-alternation system; and to compare the very low grain ration not only with a low, but, also, with a medium one. Consequently Nos. 1 and 6, the cottonseed-linseed and the gluten meal mixtures, were used; a considerable number of cows—14—were employed; and three different amounts of grain, 2, 4 and 8 pounds daily, were fed. Some cows were fed continuously 2 pounds daily throughout the course of the trials, others 4, and still others 8 pounds. Some cows alternated one period with another from 2 to 8 pounds, and others from 2 to 4 pounds. All of the cows were mature animals, save one four-year-old. Six were fresh in milk, four were 3 to 4 months in lactation, two 6 months and two 9 months along.

COMPARISON WITH STANDARDS

Very low ration.—The ten cows which either continuously or in alternation ate this ration were as a rule underfed as gauged by either the Wolff or Wolff-Lehmann standard. This statement invariably holds for digestible protein, and also for total and digestible dry matter and for carbohydrates, with but two exceptions in each standard. Serena, a light weight cow, ate enough to meet the Wolff standard requirements; Lucerne, a small cow and light milker, ate enough according to both standards; and Constance, a small cow late in lactation, consumed food equivalent to that prescribed by the Wolff-Lehmann standard. Neither of these, however, were fed enough protein.

Low ration.—Five cows were fed the low ration either in alternation or continuously. Four were underfed as judged by either standard. Lavender, a medium weight cow, a hearty eater giving but little milk, ate standard amounts—or in excess thereof—of all nutrients but protein; and she nearly met the Lehmann protein standard.

Medium ration.—The six cows thus fed ate enough to satisfy the Wolff standard, and five of them enough to meet the Lehmann standard, the sole exception being Eunice, a medium weight heavy milker.

The tabular summaries used in articles concerning feeding trials made at this Station have hitherto been of a uniform character, the voluminous data being placed in an appendix, and the concrete results alone displayed in the text. These concrete results have been termed "difference figures." It is obvious that when measuring the relative values of rations A and B it is immaterial how much milk is made when A is fed or how much when B is eaten, but that it is highly important to determine how much more is made on one ration than on the other. This excess, expressed as a percentage, is a "difference figure." These difference figures in the form of whole numbers, prefaced by their appropriate plus or minus signs, have been arranged in tabular form in the text and made the basis for conclusions as to the general result.

The deductions, moreover, have not been based on the results of a single method of calculation or of experimentation. Two systems of measurement were used, both of which are discussed in full as to their nature and validity in the article entitled "A Comparison of Feeding Trial Methods" later in this volume. Moreover, the results attained by one of these systems have been calculated in two different ways the more certainly to detect error, and because one of these methods of calculation is apt under some circumstances to afford a somewhat erroneous result. (See end of explanatory note to Table VII in appendix).

Now while these "difference figure" tabulations have been accompanied yearly by an exposition as to their nature, meaning and interpretation, they have not afforded data which "he who runs may read." Indeed, one would expect rather that their effect would be to bring about the true and ancient rendition of this old saying that "he who reads may run." It has seemed best, therefore, to footnote these figures, to use in the text only the simpler data derived by one method of calculation when results thus attained seem valid, to qualify them by footnote reference when for any reason the testimony of the other methods suggests doubt. It is thought that the accuracy of the deductions will not be impaired, that tabular matter will be more intelligible, and that the general results will be more tangible.

Following this procedure resource is had in the tables on page 474 to data in the appendix in order to determine: first, the relative worth of the very low ration and of the low ration; and, second, that of the very low and of the medium rations, the data therein being judged, when compared with that obtained by the other methods of calculation, to be safe measures of their comparative values.[1]

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[1] COMPARISON OF DIFFERENCE FIGURES (SEE NOTE TO TABLE VII APPENDIX, AS WELL AS THE FOLLOWING EXPLANATORY MATTER)

	Total dry matter eaten	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter		
							Milk	Total solids	Fat
No. 1 low to very low.									
Table VII	—11	—7	+1	+2	—5	—6	+6	+7	+7
Alternation	—12	—7	+1	+1	—6	—6	+6	+6	+6
No. 6 low to very low.									
Table VII	— 9	—5	+1	+2	—5	—3	+4	+4	+6
Alternation	—10	—6	+1	+2	—5	—4	+4	+5	+6
Contin.-Altern.	—11	—7	+2	+3	—5	—5	+4	+5	+6

(The continuous-alternation data for the two feeds are merged together).

These data are arrived at in the following manner: As the text shows, there were 1,586 pounds of dry matter eaten when the low ration was fed, and 1,405 when the very low one was used. 1,586—1,405=181 181÷1,586=.11+. The 181 pounds is 11 percent of 1,586 pounds, or, in other words, there was an 11 percent shrinkage (—11) in the food consumption. This figure (—11) is a "difference figures," and it appears at the left of the first line of the above table. The other figures in the first and third horizontal lines are similarly obtained. In the second and fourth lines, however, the figures, while similarly obtained, are derived as a result of another method of calculation, which, as explained in the text and at length in the note following Table VII in the appendix, sometimes gives more reliable results; and, finally, those in the fifth line are arrived at in yet another manner, using different cows, as explained in the article on "Comparison of Feeding Trial Methods" further along in this volume.

It would appear on reference to Table VII in the appendix that when a 4 pound daily grain ration (No. 1 feed) was reduced by 2 pounds, hay and silage being fed in similar amounts in each case, there were in 69 days' feeding:

	Low ration	Very low ration	Percentage gain or loss when very low ration was fed
Pounds of dry matter eaten	1,586	1,405	—11
Pounds of milk made	1,085	1,014	— 7
Percent total solids	14.61	14.80	+ 1
Percent fat	5.24	5.33	+ 2
Pounds of total solids made	158.6	150.0	— 5
Pounds of fat made	56.9	53.8	— 6

and that to the 100 pounds of dry matter there were made:

	Low ration	Very low ration	Percentage gain or loss when very low ration was fed
Pounds of milk	68.5	72.3	+6
Pounds of total solids	10.0	10.7	+7
Pounds of fat	3.58	3.83	+7
Ratio of fat to solids-not-fat; 1 :	1.79	1.78	—1

It would further appear that under similar conditions when the No. 6 feed was used instead of No. 1, the feeding lasting 92 days, there were:

	Low ration	Very low ration	Percentage gain or loss when very low ration was fed
Pounds of dry matter eaten	1,902	1,728	—9
Pounds of milk made	1,430	1,450	—5
Percent total solids	14.04	14.13	+1
Percent fat	4.65	4.74	+2
Pounds of total solids made	215.0	205.1	—5
Pounds of fat made	71.2	68.9	—3

and that to the 100 pounds of dry matter there were made:

	Low ration	Very low ration	Percentage gain or loss when very low ration was fed
Pounds of milk	81.1	84.3	+4
Pounds of total solids	11.4	11.9	+4
Pounds of fat	3.75	3.99	+6
Ratio of fat to solids-not-fat; 1 :	2.02	1.98	—2

It seems clear in both cases that when the low rations were still further reduced:

1. The dry matter of the ration was lowered a tenth;
2. The milk yield shrunk 5 to 7 percent;
3. The fat content was slightly increased;
4. The fat yield was lowered 3 to 6 percent; but that
5. From 5 to 7 percent more milk, total solids and fat were made to the unit of dry matter eaten.

6. Live weight records show that the cows lost heavily when scantily fed.

If recourse be now had to the same appendixed tabular statement, No. VII, it will be seen that when an 8 pound daily grain ration (No. 1 feed) was reduced to a 2 pound ration, hay and silage being fed as roughage, the following results were obtained, the feeding periods each being 69 days: [1]

	Medium ration	Very low ration	Percentage loss when very low ration was fed
Pounds of dry matter eaten	1,551	1,218	—21
Pounds of milk made	911	782	—14
Percent total solids	15.06	14.91	— 1
Percent fat	5.36	5.24	— 2
Pounds of total solids made	136.0	115.7	—15
Pounds of fat made	48.2	40.4	—16

and that to the 100 pounds of dry matter there were made:

	Medium ration	Very low ration	Percentage gain when very low ration was fed
Pounds of milk	58.6	64.1	+ 9
Pounds of total solids	8.8	9.6	+ 9
Pounds of fat	3.12	3.35	+ 7
Ratio of fat to solids-not-fat; 1 :	1.81	1.85	+ 2

When under similar circumstances the No. 6 feed was used instead of No. 1, the feeding lasting 46 days,[2] the results were as shown on the next page.

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[1] COMPARISON OF DIFFERENCE FIGURES (SEE NOTE TO TABLE VII APPENDIX, AS WELL AS TEXT AND FOOTNOTE, PAGES 472-473)

	Total dry matter eaten	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter		
							Total solids	Milk	Fat
No. 1 medium to very low									
Table VII	—21	—14	—1	—2	—15	—16	+ 9	+ 9	+ 7
Alternation	—23	—15	—2	—5	—15	—17	+ 9	+ 9	+ 7
No. 6 medium to very low.									
Table VII	—24	—15	+1	+4	—15	—12	+11	+12	+16
Alternation	—28	—16	+1	+5	—17	—13	+10	+11	+15
Contin.-Altern.	—26	—16	—1	0	—17	—16	+11	+ 9	+ 9

(The continuous-alternation data for the two feeds are merged together).

[2] Excluding Serena's most anomalous record, in which she made less milk on medium than on very low feed. See discussion in latter part of article on "Comparison of Feeding Trial Methods."

	Medium ration	Very low ration	Percentage gain or loss when very low ration was fed
Pounds of dry matter eaten	1,074	821	—24
Pounds of milk made	986	837	—15
Percent total solids	14.03	14.13	+ 1
Percent fat	4.47	4.68	+ 4
Pounds of total solids made	138.4	118.0	—15
Pounds of fat made	44.0	38.8	—12

and that to the 100 pounds of dry matter there were made:

	Medium ration	Very low ration	Percentage gain or loss when very low ration was fed
Pounds of milk	91.8	102.2	+11
Pounds of total solids	12.9	14.4	+12
Pounds of fat	4.10	4.74	+16
Ratio of fat to solids-not-fat; 1 :	2.14	2.02	— 6

It is evident in both cases where the grain ration was reduced from 8 pounds to 2 pounds that:

1. The dry matter content of the ration was lessened by 20 to 25 percent;

2. The milk yield shrunk 14 percent, the total solids yield 15 percent and the fat content 12 to 16 percent;

3. The quality of the milk was but slightly affected;

4. From 10 to 12 percent more milk, total solids and fat were made to the unit of dry matter.

5. The live weights of the scantily fed cows were greatly lessened in their efforts to maintain the milk flow.

Several cows were uniformly fed, either the very low, low, or medium rations. Their "difference figures" with but one or two exceptions had low values, indicating the small extent of the experimental error.[1]

The outcome of these trials, summarized from the standpoint of product rather than of feeding, may be stated as follows:

1. *Quantity.*—The more grain, the more milk, total solids and fat. The gains averaged 8 percent when the 4 pound ration replaced the 2 pound feed, and 14 percent when the 8 pound was used in lieu of the 2 pound ration.

2. *Quality.*—The effects were slight.

3. *Economy of production.*—A pound of dry matter made from 5 to 7 percent more milk, total solids and fat on the very low than upon the low rations, and from 8 to 13 percent more on the very low than upon the medium ration.

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[1] In this connection note article on this subject on pp. 508-509.

4. *Live weight.*—In about two-thirds of the cases the cows responded to radical changes by gaining or losing flesh according as feed was added or withdrawn. Those uniformly fed held their own, save Lady Perusia, uniformly fed the 2 pound ration during three periods, in which she lost 100 pounds. A typical dairy cow, she poured her own flesh into the milk pail.

FINANCIAL CONSIDERATIONS

The discussion thus far has been directed solely to considerations of the effect of varying grain rations on the amount and the economy of production. A more direct study of the financial side of the operation is now in order. *Does it pay to feed cows as much as 8 or as little as 2 pounds of grain daily?*

The tables on the next four pages show not only for the comparisons of the very low and low rations on page 478, and of the very low and medium rations on page 479, but also on the two succeeding pages the comparison of each ration against itself. The tables exhibit:

1. The weights of the various fodders and feeds eaten.
2. The weights of milk and butter produced.
3. The money value[1] of the food eaten.
4. The cost of food for 100 pounds of milk and for 1 pound of butter.
5. Proceeds from butter sales at 20 cents a pound.[2]
6. The fertilizing value[3] of the rations.
7. The total value of all production (butter, skimmilk[4] and two-thirds of fertilizing ingredients).
8. Gain, net gain or loss, and daily net gain or loss when one ration is compared with another.

These are shown for the experimental portions of the periods only. Lactation changes are exactly equalled by calculation; hence each ration has the same chance as its rival to prove its worth.

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[1] Hay $10, silage $3, wheat bran $19.25, cottonseed meal $28, linseed meal $29, Chicago gluten meal $28, hominy feed $22.50, dried molasses beet pulp $12, India wheat meal $32 (average market prices for grain feeds in the winter of 1903-04, and the prices paid by the Station for the pulp and India wheat). The prices used for roughage are relatively high, larger than those often used in calculations of this character. As the comparisons have only relative values, however, this is not a serious matter. It is referred to in order to forestall possible criticism as to the high cost for food of making a pound of butter. It would be easy to "figure" cheaper milk and butter.

[2] This is not the price the Station gets for its butter but simply a statement of average butter values of late years. It is, of course, a low price for winter creamery butter.

[3] Nitrogen 17½ cents, phosphoric acid 4 cents, potash 4¼ cents; 1904 trade values for the same ingredients of essentially similar availability in commercial fertilizers. It is uncertain how much of the plant food may reach the soil. This depends on many factors. It is conservative to estimate two-thirds as ultimately available.

[4] Allowing 20 cents a hundred for skimmilk, a low price in view of the present high prices for pork.

COMPARATIVE VALUES OF VARIOUS RATIONS FROM THE FINANCIAL STANDPOINT

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Gluten meal	Milk	Butter	Money value of food	Cost of food for		Proceeds from butter at 20 cents	Fertilizing value of food eaten
										100 lbs. of milk	1 lb. butter		
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	$	cts	cts	$	$

69 DAYS ON VERY LOW RATION VS. 69 DAYS ON LOW RATION (NO. 1 BRAN AND COTTONSEED AND LINSEED MEALS)

Very low	963		2070	93	46		1014	62.7	9.46	93.3	15.1	12.54	5.67
Low	1007		2066	183	93		1085	66.4	11.19	103.1	16.9	13.28	6.94
Differences in favor of low ration							+ 71	+ 3.7	+1.73	+ 9.8	+ 1.8	+0.74	+1.27
Percentage differences							+ 7	+ 6	+ 18	+ 11	+ 12	+ 6	+ 22

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; very low ration $18.09, low ration $19.81.

Difference in favor of low ration, $1.72.

Gain ($1.72), less extra cost ($1.73), gives net loss $0.01, daily net loss 0 cents.

92 DAYS ON VERY LOW RATION VS. 92 DAYS ON LOW RATION (NO. 6 BRAN AND GLUTEN MEAL)

Very low	771	814	2734	123		60	1450	80.4	11.68	80.6	14.5	16.08	7.17
Low	893	221	2785	243		121	1530	83.1	13.97	91.3	16.8	16.62	8.56
Differences in favor of low ration							+ 80	+ 2.7	+2.29	+10.7	+ 2.3	+0.54	+1.39
Percentage differences							+ 6	+ 3	+ 20	+ 13	+ 16	+ 3	+ 19

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; very low ration $23.39, low ration $25.00.

Difference in favor of low ration, $1.61.

Gain ($1.61), less extra cost ($2.29), gives net loss $0.68, daily net loss 0.74 cents.

161 DAYS ON VERY LOW RATION VS. 161 DAYS ON LOW RATION (NOS. 1 AND 6, BOTH RATIONS)

Very low	1734	814	4804	216	46	60	2464	143.1	21.14	85.8	14.8	28.62	12.84
Low	1900	221	4801	426	93	121	2615	149.5	25.16	96.2	16.9	29.90	15.50
Differences in favor of low ration							+ 151	+ 6.4	+4.02	+10.4	+ 2.1	+1.28	+2.66
Percentage differences							+ 6	+ 4	+ 19	+ 12	+ 14	+ 4	+ 21

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; very low ration $41.48, low ration $44.81.

Difference in favor of low ration, $3.33.

Gain ($3.33), less extra cost ($4.02), gives net loss $0.69, daily net loss 0.43 cents.

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Gluten meal	Milk	Butter	Money value of food	Cost of food for		Proceeds from butter at 20 cents	Fertilizing value of food eaten
										100 lbs. of milk	1 lb. butter		
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	$	cts	cts	$	$
69 DAYS ON VERY LOW RATION VS. 69 DAYS ON MEDIUM RATION (NO. 1 BRAN, COTTONSEED MEAL AND LINSEED MEAL)													
Very low	552	253	1839	92	46		782	47.2	8.31	106.3	17.6	9.44	5.30
Medium	578	196	1827	368	183		911	56.3	12.69	139.3	22.5	11.26	8.54
Differences in favor of medium ration							+ 129	+ 9.1	+4.38	+33.0	+ 4.9	+1.82	+3.24
Percentage differences							+ 16	+ 19	+ 53	+ 31	+ 28	+ 19	+ 61

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; very low ration $14.34, medium ration $18.55.

Difference in favor of medium ration, $4.21.

Gain ($4.21), less extra cost ($4.38), gives net loss $0.17, daily net loss 0.25 cents.

46 DAYS ON VERY LOW RATION VS. 46 DAYS ON MEDIUM RATION (NO. 6, BRAN AND GLUTEN MEAL)

Very low	506		1376	61		30	837	45.3	5.68	67.8	12.5	9.06	3.32
Medium	500		1378	245		123	986	51.3	8.87	90.0	17.3	10.26	5.45
Differences in favor of medium ration							+ 149	+ 6.0	+3.19	+22.2	+ 4.8	+1.20	+2.13
Percentage differences							+ 18	+ 13	+ 56	+ 33	+ 38	+ 13	+ 64

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; very low ration $12.74, medium ration $15.62.

Difference in favor of medium ration, $2.88.

Gain ($2.88), less extra cost ($3.19), gives net loss $0.31, daily net loss 0.67 cents.

115 DAYS ON VERY LOW RATION VS. 115 DAYS ON MEDIUM RATION (NOS. 1 AND 6, BOTH RATIONS)

Very low	1058	253	3215	153	46	30	1619	92.5	13.99	86.4	15.1	18.50	8.62
Medium	1078	196	3205	613	183	123	1897	107.6	21.56	113.5	20.0	21.52	13.99
Differences in favor of medium ration							+ 278	+15.1	+7.57	+27.1	+ 4.9	+3.02	+5.37
Percentage differences							+ 17	+ 16	+ 54	+ 31	+ 32	+ 16	+ 62

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; very low ration $27.08, medium ration $34.17.

Difference in favor of medium ration, $7.09.

Gain ($7.09), less extra cost ($7.57), gives net loss $0.48, daily net loss 0.42 cents.

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Gluten meal	Milk	Butter	Money value of food	Cost of food for 100 lbs. of milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	$	cts	cts	$	$

69 DAYS ON VERY LOW RATION VS. 69 DAYS ON SAME (NO. 1 BRAN, COTTONSEED MEAL AND LINSEED MEAL)

Very low I..........	446	295	2066	92	46		684	45.7	8.29	121.2	18.1	9.14	5.31
Very low II.........	567	155	2018	92	46		707	46.6	8.17	115.7	17.5	9.32	5.06
II ± I...............							+ 23	+ 0.9	−0.12	− 5.5	− 0.6	+0.18	−0.25
Percentage differences..............							+ 3	+ 2	− 1	− 5	− 3	+ 2	− 5

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; very low ration (I) $13.88, very low ration (II) $13.93.

Difference in favor of II ration, $0.05.

Gain ($0.05) plus less cost ($0.12), gives net gain $0.17, daily net gain 0.25 cents.

69 DAYS ON VERY LOW RATION VS. 69 DAYS ON SAME (NO. 6, BRAN AND GLUTEN MEAL)

Very low I..........	1029		2066	93		46	1328	79.3	9.88	74.3	12.5	15.86	5.78
Very low II.........	996		2061	93		46	1267	75.8	9.70	76.7	12.8	15.16	5.68
II ± I...............							− 61	− 3.5	−0.18	+ 2.4	+ 0.3	−0.70	−0.10
Percentage differences..............							− 5	− 4	− 2	+ 3	+ 2	− 4	− 2

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; very low ration (I) $22.04, very low ration (II) $21.16.

Difference in favor of I ration, $0.88.

Gain ($0.88), less extra cost ($0.18), gives net gain $0.70, daily net gain 1.01 cents.

69 DAYS ON LOW RATION VS. 69 DAYS ON SAME (NO. 1 BRAN, COTTONSEED AND LINSEED MEALS)

Low I................	1020		2070	183	92		878	58.7	11.26	128.3	19.2	11.74	6.98
Low II...............	1029		2065	183	92		897	59.6	11.30	126.0	19.0	11.92	7.01
II ± I...............							+ 19	+ 0.9	+0.04	− 2.3	− 0.2	+0.18	+0.03
Percentage differences..............							+ 2	+ 2	0	− 2	− 1	+ 2	0

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; low ration (I) $17.94, low ration (II) $18.16.

Difference in favor of II ration, $0.22.

Gain ($0.22), less extra cost ($0.04), gives net gain $0.18, daily net gain 0.26 cents.

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Gluten meal	Milk	Butter	Money value of food	Cost of food for		Proceeds from butter at 20 cents	Fertilizing value of food eaten
										100 lbs. of milk	1 lb. butter		
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	$	cts	cts	$	$
46 DAYS ON LOW RATION VS. 46 DAYS ON SAME (NO. 6, BRAN AND GLUTEN MEAL)													
Low I	414	57	1351	120		61	499	32.5	6.53	130.9	20.0	6.50	3.94
Low II	305	170	1354	120		61	501	32.8	6.55	130.8	20.0	6.56	4.10
II ± I							+ 2	+ 0.3	+0.02	— 0.1	0	+0.06	+0.16
Percentage differences							0	+ 1	0	0	0	— 1	+ 4

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; low ration (I) $10.00, low ration (II) $10.17.

Difference in favor of II ration, $0.17.

Gain ($0.17), less extra cost ($0.02), gives net gain $0.15, daily net gain 0.33 cents.

69 DAYS ON MEDIUM RATION VS. 69 DAYS ON SAME (NO. 1 BRAN, COTTONSEED AND LINSEED MEALS)

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Gluten meal	Milk	Butter	Money value of food	Cost of food for 100 lbs. of milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
Medium I	564	177	2044	366	183		1598	87.8	12.82	80.4	14.6	17.56	8.57
Medium II	460	291	2050	368	183		1559	87.7	12.91	82.8	14.7	17.54	8.75
II ± I							— 39	— 0.1	+0.09	+ 2.4	+ 0.1	—0.02	+0.18
Percentage differences							— 2	0	+ 1	+ 3	+ 1	0	+ 2

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; medium ration (I) $26.08, medium ration (II) $26.11.

Difference in favor of II ration, $0.03.

Gain ($0.03), less extra cost ($0.09), gives net loss $0.06, daily net loss 0.09 cents.

The following deductions seem warranted by the data in the foregoing tables:[1]

1. *Very low and low grain feeding.*—When the two rations used in this experiment were fed with hay and silage at the rate of 4 pounds instead of 2 pounds daily, 6 percent more milk and 4 percent more butter were made. The cost for making this extra product was 19 percent greater on the better ration. It cost 12 percent more to make

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[1] Neither in these comparisons nor in those of a similar nature following in this article are the costs of the manufacture of the product, of marketing it, of caring for the cows, etc., considered. These charges would be essentially the same on both sides. To admit them would only serve to obscure the one important point, namely, the comparison of the feeding values of the rations. The figures arrived at have no absolute values, but are serviceable solely for comparative purposes.

a quart of milk and 14 percent more to make a pound of butter on the 4 pound than on the 2 pound ration. There was, of course, more skimmilk made on the former ration, and it contained 21 percent more fertilizing ingredients.

The 2 pounds extra grain fed daily for 161 days cost $4.02. The increase in butter yield, however, was worth only $1.28. The extra grain ration made only 135 pounds more skimmilk, worth 27 cents; and the added manurial constituents were worth $2.66. If the former is reckoned at 20 cents a hundred, and two-thirds of the latter are included, at the prices stated in the footnote on page 477 ,the total gain as an offset against the $4.02 extra cost is $3.33. The final result of feeding 4 pounds of grain daily instead of 2 pounds is, then, a net loss of $0.69, or a daily net loss of 0.43 cents for each cow. It should be remarked, however, that the loss is entirely resident in the feeding of the No. 6 ration. When the No. 1 ration was fed, the outcome was exactly even, there being neither money gain nor loss.

2. *Very low and medium grain feeding.*—When the two rations used in these feeding trials were fed with hay and silage at the rate of 8 pounds daily instead of 2 pounds daily, 17 percent more milk and 15 percent more butter were made on the richer ration. The better ration cost, however, 54 percent more than did its competitor. Hence, it cost 31 percent more to make a quart of milk and 32 percent more to make a pound of butter on the 8 pound than on the 2 pound ration. The daily feeding of the 6 pounds extra grain for 115 days cost $7.57 more, and it only made $3.02 worth more butter, while the increase in skimmilk and in manurial values, reckoned as before, are calculated at $4.07, a total of $7.09. The net loss, then, is 48 cents, and the daily net loss for each cow is 0.42 cents, as a result of feeding 8 pounds of grain daily instead of 2 pounds. Here again the larger part of the loss is found when the No. 6 ration is used.

The salient points of the tables on pages 478-481, and of the discussion are shown herewith. The tables gives the days of feeding on each ration, the added cost for feed of the higher grade ration, the gain in proceeds from butter sales, the net loss when these alone are considered as an asset, the value of the skimmilk and of two-thirds of the manurial ingredients, the gain in proceeds from butter, skimmilk and manure, and the net loss from feeding one cow for one day on the better rations

	Very low better than low	Very low better than medium
Days of feeding on each ration	161	115
Cost of added grain feed	$4.02	$7.57
Gain from butter sales at 20 cents	$1.28	$3.02
Net loss, i. e. cost of additional grain less value of butter	$2.74	$4.55
Value of skimmilk and of two-thirds of the manurial ingredients	$2.05	$4.07
Proceeds from butter, skimmilk and manure	$3.33	$7.09
Net loss from one day's feeding of one cow	0.43 cts.	0.42 cts.

3. *Uniform feeding.*—In three cases out of five when unchanged rations were fed the results, as might have been expected, were fairly uniform. The amounts of milk and butter made, the money values of the food eaten and the costs of food for making milk and butter varied but little. Yet when these relatively small differences were translated into terms of dollars and cents some differences occur. There is only one very large discrepancy occurring when No. 6 was fed in very low amounts. This is caused by Lady Perusia's milk yield in the first period.

4. *Does it pay to feed as little as 2 pounds daily?*—Let us first exclude all items except cost of grain and butter yield. When 2 pounds of grain were fed instead of 4, $4.02 were saved on grain bills and $1.28 lost in butter not made because of scanty grain feed.

When 2 pounds of grain were fed instead of 8, $7.57 were saved on grain bills and $3.02 lost in butter not made because of the stinted grain ration.

When skimmilk and manurial values are also included we have the following showing: Saving when very low ration is substituted for the low ration, in grain $4.02, extra butter and byproducts $3.33; saving in grain when very low ration replaces medium ration $7.57, extra butter and byproducts $7.09. In other words, in this year's trial with expensive grain feeds, bran at $19.25, cottonseed, linseed and gluten meals at $28 to $29, no adequate return was obtained for a usage of grain in excess of 2 pounds daily, either in butter, or in butter, skimmilk and manure combined.

It must be confessed that this issue seems to uphold the contention of those who argue for a restricted grain ration. It is diametrically opposed to the result attained the preceding year when using cheaper feeds, bran and brewers' grains each selling at less than $20 and distillers' grain at $28. Last year "the extra cost of grain was more than paid for in increased income from butter alone when the grain ration was doubled, and three-fourths of its extra cost was thus met when the grain ration was quadrupled"; and extra skimmilk and manurial values were so much added gain.

This year's outcome seems due more particularly to two causes:

1. The high priced concentrates used.
2. The relatively small shrinkage on a restricted ration.

What is the writer's judgment in this matter? It is true that in five week periods some degree of success seems in this year's trials to have followed restricted grain feeding. It is further true that the testimony afforded by the continuously low fed cows has not been unfavorable this year to the very low ration. Yet, notwithstanding, it is the writer's judgment that the continued, month after month, year after year, stinted grain ration will not in the long run prove as profitable with the better grade of cows as will a more liberal one. Its effect on live weight, and on the persistency of the milking habit needs must be unfortunate. One has but to scan the records of these cows who have continuously been thus lightly fed during the past two winters, to note the general shrinkage in live weight and to see their relatively gaunt condition to feel at least doubtful of the wisdom of feeding such very low grain rations to good dairy cows.

III. THE FEEDING VALUE OF DRIED MOLASSES BEET PULP

It seems unlikely that the beet sugar industry will become established in New England, but it is conceivable that its byproducts may be used here. Indeed, dried molasses beet pulp is offered to some extent, and inquiries concerning it are occasionally received. It seemed worth while, therefore, to look into its merits as a feeding stuff for cows. The process of manufacture is thus described by the company which makes it:

"The beets are thoroughly washed, then shredded and placed in large cylinders. Pure water is admitted and the sugar soaked out by the diffusion process. This liquor is drawn off and the pulp, containing 92 percent moisture and one-quarter percent sugar, is conveyed at once to the drier, where it is first run through presses reducing the moisture to 82 percent. Residuum molasses from the sugar factory containing 50 percent sugar is next mixed with the pressed pulp. This mixture is then put into the kilns, where it is thoroughly dried by direct heat. The drying process lasts 35 minutes. Immediately upon coming from the kilns the pulp is sacked and is ready for shipment. The drying follows the use of the water so quickly that there is no opportunity for fermentation. One hour from the time the sugar is extracted from the beets the dried molasses beet pulp is in sacks ready for use."

Dried beet pulp, whether molasses is added to it or not, is hardly in the same class as other concentrates. Its origin and method of manufacture are so unlike them that we may expect to find its chemical composition and adaptations unusual. Such is found to be the case. Its protein content is lower than that of any ordinary concentrate except corn meal; its nitrogen-free extract and ether extract contents are low and their composition relatively poor and lacking in true starch and fat; and its crude fiber percentage is high. It cannot serve to narrow a ration since its nutritive ratio is wide. Theoretically it would seem better adapted to fattening than to milk making; but as a matter of fact it was found satisfactory in these trials.

This material was fed experimentally to ten cows. They all ate it readily and without ill effects.[1] Occasionally a cow showed some looseness of the bowels, due apparently to the feed; but nothing serious was noted.

Comparisons of this feed were made with wheat bran and with silage, with the results shown in the context.

1. COMPARED WITH WHEAT BRAN

Six cows were used in these trials. Three of these animals were fresh and three well along in milk, five mature and one heifer. Three were fed in alternation mixed feed 1 and 7, two continously on No. 7 and one on No. 1. No. 1 carried four parts of wheat bran and one part of cottonseed and linseed meals, while No. 7 contained two parts of the pulp in place of two of the bran. Two and two-thirds pounds of pulp was fed daily.

COMPARISON WITH STANDARDS

Wolff.—Atalanta ate more than standard amounts of the sundry nutrients; Elizabeth ate an excess of digestible protein. Otherwise the cows ate less than the standard prescribes.

Wolff-Lehmann.—Elizabeth, Santa Clara and Orpha ate enough digestible protein; Mona and Orpha enough digestible carbohydrates; otherwise consumption was scanty as compared with standard. Elizabeth and Orpha were the only cows which ate their full quota of food.

The outcome of the trials appears to be accurately shown by the data in Table VII, appendix.[2] These indicate that when grain feeds Nos. 1 and 7 were fed, each for 184 days, with hay and silage as roughages, there were:

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[1] Acme, an aged Ayrshire, ate three and one-third pounds daily and lost 100 pounds in live weight. These were not cause and effect, however, for her teeth failed her during the winter and she left much hay and silage.

[2] See footnote next page.

	No. 1 ration	No. 7 ration	Percentage gain or loss when No. 7 was fed[1]
Pounds of dry matter eaten.........	4,065	4,081	0
Pounds of milk made................	3,777	3,909	+4
Percent total solids	14.24	14.26	0
Percent fat	4.99	4.91	—2
Pounds of total solids made..........	529.3	547.3	+3
Pounds of fat made................	182.4	184.6	+1

and that there were made to the 100 pounds of dry matter eaten:

	No. 1 ration	No. 7 ration	Percentage gain or loss when No. 7 was fed[1]
Pounds of milk......................	92.7	95.1	+3
Pounds of total solids................	13.1	13.5	+3
Pounds of fat.......................	4.57	4.61	+1
Ratio of fat to solids-not-fat; 1 :	1.85	1.90	+3

It is clear from the above that when for two and two-thirds pounds of wheat bran in an 8 pound grain ration of bran five and one-third pounds, cottonseed meal one and one-third pounds, linseed meal one and one-third pounds (No. 1), there was substituted an equal weight (two and two-thirds pounds) of dried molasses beet pulp, there were made:

1. Four percent more milk and 1 percent more fat.
2. Three percent more milk and 1 percent more fat per unit of dry matter eaten.

When the No. 1 ration was used, 1,238 pounds of hay and 398 pounds of oat hay were fed; when the No. 7 ration was used, 1,093 and 564 pounds respectively were eaten. The oat hay carried on a dry basis 11.44 percent total protein, the other hay 9.22 percent. The protein content of the hay eaten when No. 7 was fed was about 5 pounds

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[1] COMPARISON OF DIFFERENCE FIGURES (SEE NOTE TO TABLE VII APPENDIX, AS WELL AS TEXT AND FOOTNOTE, PAGES 472-473)

	Total dry matter	Dry matter eaten in concentrates	Quantity of milk	Total solids, percent.	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter					
								In entire ration			In experimental feed		
								Milk	Total solids	Fat	Milk	Total solids	Fat
Table VII,	0	+1	+4	0	—2	+3	+1	+3	+3	+1	+2	+2	0
Altern.,	+1	+1	+4	0	—2	+3	+1	+3	+3	+1	+2	+2	0
Contin.-Altern.,	+2	+2	+3	+1	—1	+4	+2	+5	+6	+4	+2	+4	0

more than when No. 1 was used, and its carbohydrate content was lowered. The digestible protein content was probably about 2.5 pounds greater. Whether or not these were factors in the result cannot be told; but at best they can hardly have accounted for more than the observed gains. If this assumption be made it may be said that in these trials the pulp seemed as effective as was wheat bran.

FINANCIAL CONSIDERATIONS

The tabular statement shown on page 490 is quite in favor of beet pulp at $12 a ton. Not only were there 132 pounds more milk and 2.5 pounds more butter made when 535 pounds pulp replaced 539 pounds wheat bran, but the ration cost $1.71 less though carrying $1.33 less of fertilizing ingredients. The total value of butter, skimmilk and two-thirds of the fertilizing ingredients were in the two cases $64.51 and $64.30, or $0.21 in favor of the No. 1 ration. Its extra cost, however, so handicapped it that the daily net loss when No. 1 was fed was 0.82 cents.

It should be remarked, however, that this outcome is predicated on a $12 rate for pulp, the price at which it was sold at the factory. It was offered in Vermont in the fall of 1904 for $20. If this figure be used the result is very different. The 535 pounds of pulp would cost $2.14 more. The No. 1 ration would have cost 43 cents less than its competitor and would have shown a net daily gain of 0.35 cents. Twenty dollars is a high figure to ask for this material in Vermont at ruling prices for other concentrates.

2. COMPARED WITH SILAGE

Five cows were used in this trial, none of them being fresh; yet all were in milk throughout the trials, and gave from 14 to 16 pounds a day at its close. Three were fed alternately pulp and silage and two continuously on pulp. Too little silage was fed and much more dry matter was consumed on the beet pulp rations than when the dilute silage was fed.

COMPARISON WITH STANDARDS

The cows continuously fed pulp ate largely in excess of needs as judged by either standard, as did also the cows fed in alternation, while on that feed. There was a constant shortage of food, however, when silage was fed. The trials were misplanned at the outset, the very poor quality of the silage not being appreciated; but being thus started it was thought better to continue than to remodel them.

The data in Table VII seem fairly safe to use.[1] These indicate the following results when the beet pulp and corn silage were fed each for 207 days, with hay as roughage and No. 1 as concentrate:

	Silage ration	Pulp ration	Percentage gain or loss when pulp was fed
Pounds of dry matter eaten........	4,271	4,949	+16
Pounds of milk made............	2,853	3,277	+15
Percent of total solids............	14.58	14.31	— 2
Percent of fat..................	5.26	5.01	— 5
Pounds of total solids made......	405.5	463.4	+14
Pounds of fat made..............	142.2	159.5	+12

and that there were made to the 100 pounds of dry matter eaten:

	Silage ration	Pulp ration	Percentage gain or loss when pulp was fed
Pounds of milk..................	66.3	66.2	0
Pounds of total solids............	9.5	9.4	—1
Pounds of fat	3.36	3.25	—3
Ratio of fat to solids-not-fat; 1 : .	1.77	1.86	+6

The cows, when given silage, ate an average of 24.4 pounds daily, and when on pulp an average of 9.8 pounds daily, 25 and 10 pounds respectively being fed. It is clear from the figures just given that when 10 pounds pulp replaced 25 pounds silage:

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[1] COMPARISON OF DIFFERENCE FIGURES (SEE NOTE TO TABLE VII APPENDIX, AS WELL AS TEXT AND FOOTNOTE, PAGES 472-473)

	Total dry matter	Dry matter eaten in concentrates	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds dry matter					
								In entire ration			In experimental ration		
								Milk	Total solids	Fat	Milk	Total solids	Fat
Table VII,	+16	+56	+15	—2	—5	+14	+12	0	—1	—3	—27	—28	—31
Alternation,	+15	+45	+13	—2	—5	+13	+11	+1	+1	—4	—31	—34	—38
Contin.-altern.,	+14	+16	+11	—1	—3	+11	+10	—3	—2	—4	—43	—43	—45

[1] There is not as close an agreement in the results attained by the three methods of calculation in this case as could be wished. The "difference figures" given in the text for milk yield, fat percentage and total solid yield are perhaps a little high of truth; but there is so much doubt as to the value of the data secured in this case by the combined method (see article relating thereunto further on in this report) that they may well be ignored. The agreement between the other two sets of figures is good except for the experimental feed data.

1. Sixteen percent more dry matter was eaten;
2. Fifteen percent more milk was yielded;
3. Five percent poorer milk was made;
4. Twelve percent more butter fat was made; but that
5. There were equal amounts of milk made proportionate to dry matter consumption and 3 percent less fat when the pulp was fed.

This trial is a good illustration of the relation of food to milk. What would have been the outcome had enough silage been fed to have caused equivalent consumption of dry matter can only be conjectured; but the close figures obtained when the data are brought upon the same dry matter basis are indicative of a probable close similarity in feeding value for corn silage and dried molasses beet pulp, pound for pound of dry matter.

FINANCIAL CONSIDERATIONS

The tabular statement shown on page 490 is strongly in favor of the pulp ration. There were 424 pounds more milk, 202 pounds more butter and $3.32 worth more plant food to its credit than to that of the silage ration. It cost $4.51 more, but the value of the extra butter and skimmilk more than offset this, leaving the manurial ingredients brought onto the farm as so much clear gain. The total values of butter, skimmilk and two-thirds of the fertilizing ingredients were for the silage ration $54.33, and the pulp ration $61.32, a gain of $6.99. If from this figure the extra cost of the latter, $4.51, be deducted, a gain of $2.48, or 1.2 cents daily is found in favor of the pulp ration.

It has already been noted that the pulp was figured at $12, its factory cost, and that it was offered in Vermont in the fall of 1904 at $20. If this price be used the outcome is reversed. The extra cost of the pulp ration becomes $12.60 instead of $4.51; there is a loss instead of a gain amounting to $5.61 or a net loss of 2.71 cents a day.

It would seem that dried molasses beet pulp proved itself in these trials a good feed for cows, a fair equivalent pound for pound of wheat bran, and, less certainly, a fair equivalent, about pound for pound of dry matter, of immature corn silage. At $12, for which sum it has been sold in the beet sugar districts, it would seem well worth buying; but at $20 it is not as good a purchase as bran, even at ruling high prices for that concentrate; nor is it likely to prove a wise purchase even at a much lower figure to use in lieu of mature corn silage.

COMPARATIVE VALUES OF VARIOUS RATIONS FROM THE FINANCIAL STANDPOINT

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Beet pulp	Milk	Butter	Money value of food	Cost of food for		Proceeds from butter at 20 cents	Fertilizing value of food eaten
										100 lbs. of milk	1 lb. butter		
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	$	cts	cts	$	$
184 DAYS ON NO. 1 RATION VS. 184 DAYS ON NO. 7 RATION													
No. 1	1238	398	5434	1074	587		3777	212.8	34.10	90.2	16.0	42.56	22.96
No. 7	1098	564	5426	535	535	535	3909	215.3	32.19	82.3	14.9	43.06	21.63
No. 7 ± 1							+ 132	+ 2.5	−1.71	− 7.9	− 11	+0.50	−1.33
Percentage differences							+ 3	+ 1	− 5	− 9	− 7	+ 1	− 6

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration $64.51, No. 7 ration $64.30.

Difference in favor of No. 1 ration, $0.21.

Gain ($0.21), less extra cost ($1.71), gives net loss $1.50, daily net loss 0.82 cents.

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Beet pulp	Milk	Butter	Money value of food	Cost of food for 100 lbs. of milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
69 DAYS ON NO. 1 RATION VS. 69 DAYS ON SAME													
No. 1 I	311	216	1380	366	183		979	68.1	10.79	11.0	15.8	13.62	7.49
No. 1 II	392	126	1373	365	181		910	66.5	10.66	11.7	16.0	13.30	7.30
II ± I							− 69	− 1.6	−0.13	+ 0.7	+ 0.2	−0.32	−0.19
Percentage differences							− 7	− 2	− 1	+ 6	+ 1	− 2	− 3

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration (I) $20.33, No. 1 ration (II) $19.76.

Difference in favor of I ration, $0.57.

Gain ($0.57), less extra cost ($0.13), gives net gain $0.44, daily net gain 0.64 cents.

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Beet pulp	Milk	Butter	Money value of food	Cost of food for 100 lbs. of milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
92 DAYS ON NO. 7 RATION VS. 92 DAYS ON SAME													
No. 7 I	530	338	2118	286	286	286	1886	75.8	15.95	84.6	21.0	15.16	10.98
No. 7 II	586	226	2131	286	286	286	1877	76.3	15.69	83.7	20.6	15.26	10.68
II ± I							− 9	+ 0.5	−0.26	− 0.9	− 0.4	+0.10	−0.30
Percentage differences							0	+ 1	− 2	− 1	− 2	+ 1	− 3

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 7 ration (I) $25.79, No. 7 ration (II) $25.68.

Difference in favor of I ration, $0.11.

Gain ($0.11), less extra cost ($0.26), gives net loss $0.15, daily net loss 0.16 cents.

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Beet pulp	Milk	Butter	Money value of food	Cost of food for		Proceeds from butter at 20 cents	Fertilizing value of food eaten
										1 lb. butter	100 lbs. milk		
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	$	cts	cts	$	$
207 DAYS ON SILAGE VS. 207 DAYS ON MOLASSES BEET PULP													
Silage	1412	315	5054	1187	594		2853	165.9	35.88	125.8	21.6	33.18	24.25
Pulp	1488	247		1184	598	2022	3277	186.1	40.39	123.3	21.7	37.22	27.57
Pulp ± silage							+ 424	+20.2	+4.51	− 2.5	+ 0.1	+4.04	+3.32
Percentage differences							+ 15	+ 12	+ 13	− 2	0	+ 12	+ 14

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; silage ration $54.33, beet pulp ration $61.32.

Difference in favor of beet pulp ration, $6.99.

Gain ($6.99), less extra cost ($4.51), gives net gain $2.48, daily net gain 1.20 cents.

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Beet pulp	Milk	Butter	Money value of food	Cost of food for 1 lb. butter	Cost of food for 100 lbs. milk	Proceeds from butter at 20 cents	Fertilizing value of food eaten
138 DAYS ON MOLASSES BEET PULP VS. 138 DAYS ON SAME													
Beet pulp I	1071	89		681	342	1208	2140	149.6	24.36	114.0	16.3	29.92	16.46
Beet pulp II	958	179		711	354	1258	2238	153.8	24.98	111.6	16.2	30.76	17.01
II ± I							+ 98	+ 4.2	+0.62	− 2.4	− 0.1	+0.84	+0.55
Percentage differences							+ 5	+ 3	+ 3	− 2	− 1	+ 3	+ 3

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; beet pulp ration (I) $44.63, beet pulp ration (II) $46.01.

Difference in favor of II ration, $1.38.

Gain ($1.38), less extra cost ($0.62), gives net gain $0.76, daily net gain 0.55 cents.

IV. THE FEEDING VALUE OF INDIA WHEAT MEAL.

"India wheat" is a plant of the buckwheat family,[1] grown to quite an extent in Vermont hill towns. Its seed when ground is commonly used there like the common buckwheat flour for human food and also as a cattle food. It rarely enters into trade as a cattle feed, being simply a home grown concentrate. Its use seems to be lessening, but it still cuts quite a figure in the feeding practice on many farms back from the railroads and out of easy access to the byproducts now so widely offered. So far as is known no estimation of its feeding value has ever been made. Two trials were planned with a view of filling this gap, one comparing it with wheat bran and one with cottonseed and linseed meals.

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[1] This India (Indian) or Tartary wheat (*Fagopyrum Tartaricum*) differs from the common buckwheat (*F. esculentum*) in having the grains smaller, dull. roughish, with angles wavy and less acute.

The meal fed in these trials was somewhat irregular in composition. It averaged about 2 percent richer in protein than the whole buckwheat and 5 percent richer than buckwheat flour. It carried considerably less nitrogen-free extract matter than average buckwheat flour, and 2 percent more protein and 4 percent less nitrogen-free extract matter than average corn meal. It is obviously not adapted to narrowing a ration. It was freely eaten without any observed ill effects, two and two-thirds pounds daily being fed in combination with bran (as feed No. 2), or with bran, cottonseed and linseed meals (as feed No. 3).

1. COMPARED WITH WHEAT BRAN

Six cows were used in the trial with wheat bran, five mature and one a heifer, five fresh in milk and one farrow at the outset, having been a year in milk. Three of these were fed mixed feeds 1 and 3 in alternation, two No. 3 and one No. 1 continuously.

COMPARISON WITH STANDARDS

Wolff.—The four mature fresh cows ate a sufficiency of nutrients, but the farrow cow and the three-year-old did not eat enough to meet the demands of the standard.

Wolff-Lehmann.—The exact reverse of the statement just made obtains with this standard. The four mature fresh cows making 25 to 30 pounds of milk daily did not get food enough to satisfy the requirements of the standard, while the two which, on account of long lactation on the one hand and youth on the other, made but little milk, ate enough and to spare.

The result of this trial seems fairly measured by the data presented in Table VII in the appendix.[1] These indicate that when grain feeds Nos. 1 and 3 were fed, each for 161 days, with hay and silage as roughages, there were:

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[1] The "difference figures" afforded by the combined continuous-alternation system are faulty, yet the comparison is not an extremely bad one; those obtained by alternation are identical with those of Table VII. See remainder of footnote statement on page 493.

	No. 1 ration	No. 3 ration	Percentage gain or loss when No. 3 was fed
Pounds of dry matter eaten........	3,136	3,136	0
Pounds of milk made..............	2,744	2,709	—1
Percent total solids................	15.00	14.98	0
Percent fat	5.52	5.47	—1
Pounds of total solids made........	387.9	387.3	0
Pounds of fat made................	132.9	133.4	0

This trial further shows that there were made to the 100 pounds of dry matter eaten:

	No. 1 ration	No. 3 ration	Percentage gain or loss when No. 3 was fed
Pounds of milk....................	79.8	79.8	0
Pounds of total solids.............	11.5	11.5	0
Pounds of fat.....................	4.00	4.02	+1
Ratio of fat to solids-not-fat; 1 : ..	1.72	1.74	+1

A closer outcome could not have been looked for on uniform feeding. What minute difference occurs favors the No. 1 ration. Unfortunately the oat hay feeding introduces an element of doubt. When the No. 1 ration was fed, 1,229 pounds of hay and 148 pounds of oat hay were fed; when the No. 3 ration was used 1,086 and 339 pounds respectively were eaten. The protein content of the hay eaten when the No. 3 ration was fed was over 4 pounds greater than that consumed when No. 1 was used; and its carbohydrate content was lowered. The digestible protein content was probably about 2 pounds greater. Whether or not this was a factor in the result cannot be told. Its effect if any would seem more likely to have increased than decreased the milk flow, and hence to have afforded the India wheat ration undue

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[1] COMPARISON OF DIFFERENCE FIGURES (SEE NOTE TO TABLE VII APPENDIX, AS WELL AS TEXT AND FOOTNOTE, PAGES 472-473)

	Total dry matter eaten	Dry matter in experimental feed	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter					
								In entire ration			In experimental feed		
								Milk	Total solids	Fat	Milk	Total solids	Fat
Table VII,	0	—1	—1	0	—1	0	0	0	0	+1	0	+1	+1
Alternation,	0	—1	—1	0	—1	0	+1	—1	+1	+1	0	+1	+2
Contin.-Altern.,	—3	0	+1	—2	—4	—1	—3	+4	+2	—1	+1	0	—3

aid. Bearing this in mind one seems warranted in saying that the India wheat meal proved nearly if not quite as good a milk maker as did the bran.

FINANCIAL CONSIDERATIONS

There is no market for or quotations of India wheat. It is locally ground for the owners. The Station bought it from an Orange county miller in small lots at a relatively large price ($32), one which was prohibitively high; hence the calculation of the money side of the matter has really but little value. It is given, however, as a matter of record.

The tabular statement on page 497 is all in favor of the No. 1 ration. It made more milk, as much butter, cost less and made better manure. The total value of butter, skimmilk and two-thirds of the fertilizing ingredients for 161 days on each ration were, No. 1, $47.34; No. 3, $46.70; or 64 cents in its favor. It cost 86 cents less and figures a daily net gain per cow of 0.93 cents. If, however, the India wheat can be grown and the meal made at not to exceed $20 a ton, one might expect—judging by the result of this single trial alone—to find it as serviceable as is wheat bran at the same price. It should be remarked, however, that it is a "heavy" meal, that it does not possess the well-known mechanical properties of bran, and that it is less well adapted than this bran to form the bulk of the grain ration.

2. COMPARISON WITH COTTONSEED AND LINSEED MEALS

Six cows were used, four mature, two with their first calves, all well along in lactation, and two of them farrow. Three were fed grain feeds No. 1 and 2 in alternation, two No. 2, and one No. 1 continuously. Each feed contained bran, cottonseed and linseed meals. No. 2 contained India wheat meal in addition to and in place of one-half of the bran.

COMPARISON WITH STANDARDS

Wolff.—Speaking broadly the rations eaten were less rather than more than standard in amount. This statement is particularly true of the protein when No. 2 was fed. Eva and Mermaid ate in excess of standard, except of protein. Queenie ate far less than she should have done.

Wolff-Lehmann.—Total dry matter consumption was less than standard; in all other respects standard or more than standard amounts were eaten.

The outcome of these trials is displayed in the data given below, drawn from Table VII in the appendix, which is amply confirmed by that obtained by the other method.[1]

These indicate that when two and two-thirds pounds India wheat meal is substituted in an 8 pound daily grain ration for an equal amount of half cottonseed and half linseed meal,—hay and silage as roughages and twice as much bran as the main concentrate being fed for a length of 207 days on each ration,—there were made:

	No. 1 ration	No. 3 ration	Percentage gain or loss when No. 2 was fed
Pounds of dry matter eaten........	4,281	4,259	—1
Pounds of milk made..............	2,480	2,422	—2
Percent of total solids.............	16.70	16.75	0
Percent of fat....................	6.59	6.59	0
Pounds of total solids made........	413.7	405.7	—2
Pounds of fat made...............	162.3	158.9	—2

This trial further shows that there were made to the 100 pounds of dry matter eaten:

	No. 1 ration	No. 3 ration	Percentage gain or loss when No. 2 was fed
Pounds of milk	57.5	56.5	—2
Pounds of total solids..............	9.6	9.5	—1
Pounds of fat.....................	3.79	3.73	—2
Ratio of fat to solids-not-fat; 1 : ..	1.53	1.54	+1

According to this showing, when the India wheat meal was substituted for the byproducts of the oil mills, there were made:

1. Only 2 percent less milk, solids, fat and butter;
2. As rich milk;

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[1]COMPARISON OF DIFFERENCE FIGURES (SEE NOTE TO TABLE VII APPENDIX, AS WELL AS TEXT AND FOOTNOTE, PAGES 472-473)

	Total dry matter eaten	Dry matter eaten in concentrates	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter					
								In entire ration			In experimental feed		
								Milk	Total solids	Fat	Milk	Total solids	Fat
Table VII,	—1	—3	—2	0	0	—2	—2	—2	—1	—2	+1	+2	+2
Alternation,	—2	—4	—3	+1	0	—2	—3	—2	—2	—2	+1	+2	+2
Contin.-altern.,	—2	—4	—3	+1	+2	—3	—2	—3	—2	—2	+1	+2	+2

3. But 2 percent less production to the unit of dry matter eaten.

The oat hay—hitherto mentioned as possibly a disturbing factor—was fed in the larger amount when the No. 1 feed was used (No. 1, 1,584 pounds ordinary hay, 424 pounds oat hay; No. 2, 1,627 and 370 pounds respectively). This difference is too slight to have had appreciable effect. It seems safe to conclude that in these trials the India wheat meal proved almost if not quite equal in feeding value to the mixture of half cottonseed and half linseed meals.

FINANCIAL CONSIDERATIONS

For the reasons cited on page 494, the validity of the monetary estimate of the India wheat ration is questionable. The tabular statement on page 497 favors the No. 1 ration . The usual calculations of the value of the butter, skimmilk and two-thirds of the manurial constituents show for No. 1, $57.79, and for No. 2, $53.83. The former cost 87 cents more than the latter; hence the net gain was $3.09 and the daily net gain 1.49 cents. If the India wheat meal is rated at $20, most, but not all, of this difference disappears, the rations being nearly on a parity. Most of the gain in either case is found in the extra amount of manurial constituents brought onto the farm when the by-products are purchased.

The ground meal does not appear to keep well, after the spring weather comes on, due probably to its considerable moisture content. So far as single trials can determine, India wheat meal seems a fair substitute for standard concentrates like wheat bran, and cottonseed and linseed meals, pound for pound, when fed in quantities of less than 3 pounds daily per cow. This outcome is not one which the analysis of the meal would have led one to anticipate. The cow, in other words, seems to find more milk-making food in India wheat than does the chemist.

COMPARATIVE VALUES OF VARIOUS RATIONS FROM THE FINANCIAL STANDPOINT

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	India wheat meal	Milk	Butter	Money value of food	Cost of food for		Proceeds from butter at 20 cents	Fertilizing value of food eaten
										100 lbs. milk	1 lb. butter		
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	$	cts	cts	$	$

161 DAYS ON NO. 1 RATION ± 161 DAYS ON NO. 3 RATION

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	India wheat meal	Milk	Butter	Money value of food	Cost of food for 100 lbs. milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
No. 1	1229	148	4099	817	378		2744	155.1	26.14	95.2	16.9	31.02	17.29
No. 3	1086	339	4116	381	381	380	2709	155.6	27.00	99.6	17.4	31.12	16.25
No. 3 ± No. 1							— 35	+ 0.5	+0.86	+ 4.4	+ 0.5	+0.10	—1.04
Percentage differences							— 1	0	+ 3	+ 5	+ 3	0	— 6

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration $47.34, No. 3 ration $46.70.

Difference in favor of No. 1 ration, $0.64.

Gain ($0.64), plus lessened cost ($0.86), gives net gain $1.50, daily net gain 0.93 cents.

46 DAYS ON NO. 1 RATION VS. 46 DAYS ON SAME

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	India wheat meal	Milk	Butter	Money value of food	Cost of food for 100 lbs. milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
No. 1 I	441	60	1378	245	122		1334	68.6	8.62	64.6	12.6	13.72	5.68
No. 1 II	321	183	1372	246	122		1251	67.4	8.64	69.1	12.8	13.48	5.85
II ± I							— 83	— 1.2	+0.02	+ 4.5	+ 0.2	—0.24	+0.17
Percentage differences							— 6	— 2	0	+ 7	+ 2	— 2	+ 3

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration (I) $19.83, No. 1 ration (II) $19.56.

Difference in favor of I ration, $0.27.

Gain ($0.27), plus less cost ($0.02), gives net gain $0.29, daily net gain 0.63 cents.

115 DAYS ON NO. 3 RATION VS. 115 DAYS ON SAME

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	India wheat meal	Milk	Butter	Money value of food	Cost of food for 100 lbs. milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
No. 3 I	860	336	3379	304	305	304	1710	106.6	21.99	124.0	20.6	21.32	13.29
No. 3 II	816	303	3241	307	306	307	1716	103.1	21.50	125.3	20.9	20.62	12.97
II ± I							+ 6	— 3.5	—0.49	+ 1.3	+ 0.3	—0.70	—0.32
Percentage differences							0	— 3	— 2	+ 1	+ 1	— 3	— 2

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 3 ration (I) $33.18, No. 3 ration (II) $32.29.

Difference in favor of I ration, $0.89.

Gain ($0.89), less extra cost ($0.49), gives net gain $0.40, daily net gain 0.35 cents.

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	India wheat meal	Milk	Butter	Money value of food	Cost of food for		Proceeds from butter at 20 cents	Fertilizing value of food eaten
										1 lb. butter	100 lbs. milk		
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	$	cts	cts	$	$
207 DAYS ON NO. 1 RATION ± 207 DAYS ON NO. 2 RATION													
No. 1	1584	424	5485	1008	504		2480	189.4	34.96	141.0	18.5	37.88	23.35
No. 2	1627	370	5466	999		500	2422	185.4	34.09	140.9	18.4	37.08	18.77
No. 2 ± No. 1							— 58	— 4.0	—0.87	— 0.1	— 0.1	—0.80	—4.58
Percentage differences							— 2	— 2	— 2	0	— 1	— 2	— 20

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration $57.79, No. 2 ration $53.83.

Difference in favor of No. 1 ration, $3.96.

Gain ($3.96), less extra cost ($0.87), gives net gain $3.09, daily net gain 1.49 cents.

23 DAYS ON NO. 1 RATION VS. 23 DAYS ON SAME

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	India wheat meal	Milk	Butter	Money value of food	Cost of food for 1 lb. butter	Cost of food for 100 lbs. milk	Proceeds from butter at 20 cents	Fertilizing value of food eaten
No. 2 I	131	115	656	118	59		224	14.2	4.17	186.2	29.4	2.84	2.85
No. 2 II	138	111	685	123	61		248	15.5	4.30	173.4	27.7	3.10	2.93
II ± I							+ 24	+ 1.3	+0.13	—12.8	— 1.7	+0.26	+0.08
Percentage differences							+ 11	+ 9	+ 3	— 7	— 6	+ 9	+ 3

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration (I) $5.13, No. 1 ration (II) $5.48.

Difference in favor of II ration, $0.35.

Gain ($0.35), less extra cost ($0.13), gives net gain $0.22, daily net gain 0.96 cents.

92 DAYS ON NO. 2 RATION VS. 92 DAYS ON SAME

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	India wheat meal	Milk	Butter	Money value of food	Cost of food for 1 lb. butter	Cost of food for 100 lbs. milk	Proceeds from butter at 20 cents	Fertilizing value of food eaten
No. 1 I	581	375	2509	454		227	1125	87.8	15.51	137.9	17.7	17.56	8.78
No. 1 II	647	229	2498	452		226	1072	85.7	15.34	143.4	17.9	17.14	8.52
II ± I							— 53	— 2.1	—0.17	+ 5.5	+ 0.2	—0.42	—0.26
Percentage differences							— 5	— 2	— 1	+ 4	+ 1	— 2	— 3

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 2 ration (I) $25.39, No. 2 ration (II) $24.69.

Difference in favor of I ration, $0.70.

Gain ($0.70), less extra cost ($0.17), gives net gain $0.53, daily net gain 0.58 cents.

V. THE FEEDING VALUE OF HOMINY FEED

Hominy feed or chop is a byproduct of the manufacture of hominy, a human food largely used in the South. The harder and outer portions of the corn kernel are separated from the softer or inner part and the germ by mechanical means, the former constituting the hominy used for human feeding and the latter the chop used as a cattle food.

The distinctive differences in the composition of the corn kernel and the two derivatives are shown below, the analyses being calculated to a common moisture basis:

	Water	Crude ash	Crude protein	Crude fiber	Nitrogen-free extract	Ether extract
Corn meal	15	1.4	9.2	1.9	68.7	3.8
Hominy	15	0.4	8.2	1.0	75.0	0.4
Chop	15	2.4	9.4	3.6	61.6	8.0

The chop varies from the corn meal mainly in its fat content, which, however, seems somewhat less digestible. Its protein content, on the other hand, is somewhat more digestible than that of corn meal. Hominy feed is sold quite extensively in New England and enjoys considerable esteem among dairymen as a milk-maker. No experimental trials of its merits are known to the writer; hence it seemed worth while to define more clearly its location in the list of dairy feeding stuffs. Three trials were made during the year designed to measure its feeding value as compared with wheat bran, gluten meal and with a mixture of cottonseed and linseed meals, 16 cows being used.

1. COMPARED WITH WHEAT BRAN

Six cows, four being nine months in milk, two four months along in milk, and all with calf, were chosen for this trial. They obviously were not the pick of the herd, yet they served the purpose fairly well. Three ate in alternation (two for three periods only) grain feeds Nos. 1 and 5, while two were fed No. 5 and one, No. 1 continuously.

COMPARISON WITH STANDARDS

Wolff.—Two cows ate enough, two a little less than enough and two far too little to meet standard requirements.

Wolff-Lehmann.—Four cows ate enough digestible dry matter and carbohydrates and all ate enough digestible protein; two, however, failed to get enough dry matter and carbohydrates to fulfill the standard requirements.

The outcome of this trial seems to be correctly summarized in Table VII, from which the following data are drawn:[1]

It appears that when two and two-thirds pounds of hominy feed were substituted for an equal weight of wheat bran in an 8 pound grain ration containing bran, cottonseed and linseed meals,—one-half of the bran being thus replaced,—hay and silage being fed as roughage, there were made in 115 days' feeding on each ration:

	No. 1 ration	No. 5 ration	Percentage gain or loss when No. 5 was fed
Pounds of dry matter eaten........	2,499	2,499	0
Pounds of milk made..............	1,556	1,613	+4
Percent total solids	14.88	14.71	—1
Percent fat	5.20	5.12	—2
Pounds of total solids made........	229.5	233.6	+2
Pounds of fat made................	79.5	80.2	+1

and that to the 100 pounds of dry matter eaten there were made:

	No. 1 ration	No. 5 ration	Percentage gain or loss when No. 5 was fed
Pounds of milk	62.4	64.9	+4
Pounds of total solids..............	9.2	9.4	+2
Pounds of fat.....................	3.18	3.22	+1
Ratio of fat to solids-not-fat; 1 : ...	1.86	1.87	+1

These figures indicate that the hominy feed ration, both directly and per unit of dry matter made as compared with the full bran ration:

1. Four percent more milk;
2. Two percent poorer milk;
3. One percent more fat.

In this trial the hominy feed appears to outrank its competitor for milk production and to equal it for butter production.

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[1] COMPARISON OF DIFFERENCE FIGURES (SEE NOTE TO TABLE VII APPENDIX, AS WELL AS TEXT AND FOOTNOTE, PAGES 472-473)

	Total dry matter eaten	Dry matter eaten in concentrates	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter					
								In entire ration			In experimental feed		
								Milk	Total solids	Fat	Milk	Total solids	Fat
VII,	0	0	+4	—1	—2	+2	+1	+4	+2	+1	+3	+1	+1
Alternation,	0	+1	+4	—2	—3	+2	+1	+4	+3	+1	+3	+1	0
Contin.-altern.,	—1	0	+4	—3	—5	+2	—1	+5	+3	+1	+4	+1	—1

FINANCIAL CONSIDERATIONS

The tabular statement on page 507 shows that the No. 1 ration yielded in butter, skimmilk and fertilizing ingredients $30.73, and the No. 5 ration $30.26. The former, moreover, cost 26 cents less, hence the net gain is 0.64 cents daily.

The No. 1 ration came out ahead, but solely on account of its extra manurial value. The No. 5 ration made 18 cents worth more butter and 9 cents worth more skimmilk, and it cost 26 cents more, a gain of only one cent. But a dollar and eleven cents worth of total extra plant food, or even two-thirds of this sum (which represents what is assumed to be available), is worth the extra cent several times over.

Viewed solely from the standpoint of milk-making and disregarding the plant food item, hominy feed would seem in this trial to have equalled or perhaps slightly outranked wheat bran at $22.50 and $19.50 respectively. When manurial values are reckoned upon it comes out distinctly second. To afford a money equivalent to bran at $19.50 it would have had to be sold at $20.

2. COMPARED WITH COTTONSEED AND LINSEED MEALS

Six cows were chosen, five mature, one with her first calf, three fresh, one a month, one three months and one four months along; three being fed in alternation, grain feeds 1 and 4, two No. 4, one one No. 1 continuously. Both rations were readily eaten.

COMPARISON WITH STANDARDS

Wolff.—Two cows ate too little, two ate too much and two enough total and digestible dry matter and of carbohydrates. When No. 4 was fed protein was always short, but not when No. 1 was used.

Wolff-Lehmann.—Digestible dry matter and carbohydrates were insufficient only in the case of one large cow. Protein was always lacking when No. 4 was fed.

The outcome of this trial is fairly well indicated by the figures derived from Table VII in the appendix.[1] It appears that when two and two-thirds pounds of hominy feed was substituted for an equal weight of a mixture of half cottonseed and half linseed meals, bran being also fed in each case, and hay and silage used as roughages, the results were as follows from 161 days' feeding on each ration:

	No. 1 ration	No. 4 ration	Percentage gain or loss when No. 4 was fed
Pounds of dry matter eaten........	3,222	3,330	+3
Pounds of milk made..............	2,683	2,747	+2
Percent total solids...............	14.64	14.23	—3
Percent fat	5.06	4.78	—6
Pounds of total solids made........	390.5	389.4	0
Pounds of fat made...............	134.8	131.2	—3

and that to the 100 pounds of dry matter eaten there were made:

	No. 1 ration	No. 4 ration	Percentage gain or loss when No. 4 was fed
Pounds of milk...................	82.7	82.4	0
Pounds of total solids.............	12.1	11.7	—3
Pounds of fat	4.16	3.92	—6
Ratio of fat to solids-not-fat; 1 : ..	1.89	1.98	+5

The latter figures are in three cases a little wide of the others, being due to the eccentricities of Hallowe'en, as set forth in the article comparing methods of feeding trials further along in this report. The figures indicate that the hominy feed ration made, as compared with the cottonseed-linseed rations:

1. Two percent more milk;
2. Six percent poorer milk;

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[1] COMPARISON OF DIFFERENCE FIGURES (SEE NOTE TO TABLE VII APPENDIX, AS WELL AS TEXT AND FOOTNOTE, PAGES 472-473)

	Total dry matter eaten	Dry matter eaten in concentrates	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter					
								In entire ration			In experimental feed		
								Milk	Total solids	Fat	Milk	Total solids	Fat
VII,	+3	0	+2	—3	—6	0	—3	0	—3	—6	+2	—1	—4
Alternation,	+3	0	+3	—3	—6	—1	—3	—1	—3	—6	+2	—1	—4
Contin.-Altern.,	+2	0	—1	—2	—2	—2	—3	—3	—5	—6	—1	—2	—3

3. Three percent less fat;

that to the unit of dry matter it made:

4. No more milk, and
5. Six percent less fat; and that
6. The quality of the milk was so affected as to cause a disproportionate drop in its fat content, an unusual occurrence and one on which, because of lack of confirmation[1] in the trials when No. 5 was fed, no stress should be laid. It was sufficient, however, to convert a gain in milk into a loss in fat, which on an equal dry matter basis is a considerable one (6 percent). This peculiar result was obtained with each of the three cows fed in alternation. It is the controlling factor in this particular trial. If confirmed by further tests it would look as if hominy chop were a better milk-maker than butter-maker.

FINANCIAL CONSIDERATIONS

The tabular statement on page 506 shows the situation when viewed from the money standpoint. When each ration was fed 161 days the butter, skimmilk and fertilizing ingredients (the latter discounted a third) totalled for the No. 1 ration $48.28, and for the No. 4 ration $45.36, a gain in favor of the former of $2.92. It cost 58 cents more, however, making the net gain $2.34 or 1.45 cents a day, most of which was due to the increased plant food furnished by the richer byproducts. In other words, the extra 84 cents of butter made on the No. 1 ration did not much more than compensate for its added cost. It would appear, then, that hominy meal at $22.50 did not compare favorably with cottonseed and linseed meals at $28 and at $29 respectively.

3. COMPARED WITH GLUTEN MEAL

Since it is a fact that hominy feed and gluten meal are each byproducts of corn, though very different in their character and composition, it seemed worth while to note their comparative merits as judged by feedng trials.

Four cows were chosen for this trial and the records of other cows fed No. 4 continuously in another test are also available. Three of these cows were mature animals and one was a three-year-old. Two were fresh in milk, one three months in milk (after abortion) and one eight months in lactation. These were fed in alternation, and one fed No. 4 continuously. None were fed No. 6.

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[1] The milk given when No. 5 was fed against No. 1 and when No. 4 was fed against No. 6 was poorer in both cases, but not to the same extent as in this trial.

COMPARISON WITH STANDARDS

Wolff.—Two cows of medium weight, milking heavily, ate a plenty—save of protein—when No. 4 was fed. The other two heavier cows, giving but little milk, ate too little to meet the standard requirements, based on weight alone.

Wolff-Lehmann.—The reverse of the above statement holds for the standard, which graduates food needs according to milk yield as well as weight. The heavy weight, light milkers, ate plenty, while the ration ate by the medium weight, heavy milkers was slightly lacking in digestible food ingredients, though containing enough carbohydrates.

The result of this trial is exhibited in the following excerpt from Table VII in the appendix.[1] It appears that when in an 8 pound daily grain ration, of two parts wheat bran and one part gluten meal, there is substituted in place of the gluten meal an equal weight of hominy feed, hay and silage being fed as roughages, the outcomes from 184 days' feeding on each ration were as follows:

	No. 6 ration	No. 4 ration	Percentage gain or loss when No. 4 was fed
Pounds dry matter eaten..........	4,183	4,214	1
Pounds milk made.................	3,069	2,961	—4
Percent total solids	15.07	15.00	0
Percent fat	5.46	5.43	—1
Pounds of total solids made........	449.3	431.6	—4
Pounds of fat made...............	158.6	152.4	—4

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[1] The data used here is confirmed by that obtained by the alternation method of measurement, but not quite so well by that obtained by the continued method. owing to irregularities in the record of a single cow, Hallowe'en, continuously fed the No. 4 method.

[1]COMPARISON OF DIFFERENCE FIGURES (SEE NOTE TO TABLE VII APPENDIX, AS WELL AS TEXT AND FOOTNOTE, PAGES 472-473)

	Total dry matter eaten	Dry matter eaten in concentrates	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter					
								In entire ration			In experimental feed		
								Milk	Total solids	Fat	Milk	Total solids	Fat
VII,	—1	0	+4	0	+1	+4	+4	+4	+5	+5	+4	+4	+4
Alternation,	—1	—2	+4	+1	+1	+4	+4	+4	+5	+5	+4	+5	+5
Contin.-altern.,	+1	0	+7	—2	—4	+6	+3	+7	+5	+2	+7	+6	+3

It further appears that the following products resulted for each 100 pounds of dry matter eaten:

	No. 6 ration	No. 4 ration	Percentage gain or loss when No. 4 was fed
Pounds of milk	72.8	69.8	—4
Pounds of total solids	10.7	10.2	—5
Pounds of fat	3.78	3.60	—5
Ratio of fat to solids-not-fat; 1 :	1.76	1.76	0

These figures are clear and unequivocal and indicate that in these trials, when hominy feed was substituted for gluten meal, there were made:

1. Four percent less milk, total solids and fat;
2. Milk of unchanged quality;

and that to the unit of dry matter eaten there were made:

3. Four percent less milk and 5 percent less solids and fat.

The oat hay was fed much more largely during the hominy than during the gluten periods, and its influence, if any, would probably have been to depress the figures, which would appear, if anything, to be understatements.

FINANCIAL CONSIDERATIONS

The monetary side of the comparison is shown on page 507. When these two rations were fed for 184 days each, No. 6 yielded in butter, skimmilk and manurial ingredients (two-thirds) $57.02, and No. 4, $53.54, a gain in favor of the former of $3.48. It cost, however, $2.19 more. The net gain is therefore $1.29 or 0.7 cents daily in favor of the gluten meal ration.

The gain here, as has been so generally the case, is one of manurial constituents alone. The gluten meal cost $5.50 a ton more than did the hominy feed. The amount eaten—489 pounds—cost over $2 more than did the equal weight of hominy feed; and there were made only 7.2 pounds more butter, valuing at $1.44. The extra skimmilk does not go far towards closing the gap. Plant food, however, is bought very cheaply in this manner, and is usually an advisable purchase. As judged by this single trial, hominy feed to be on a parity with gluten meal at $28 ought to sell at $13, a price which, of course, it will never attain.

COMPARATIVE VALUES OF VARIOUS RATIONS FROM THE FINANCIAL STANDPOINT

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Hominy feed	Milk	Butter	Money value of food	Cost of food for 100 lbs. milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	$	cts	cts	$	$

161 DAYS ON NO. 1 RATION VS. 161 DAYS ON NO. 4 RATION

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Hominy feed	Milk	Butter	Money value of food	Cost of food for 100 lbs. milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
No. 1	1206	88	4350	889	445		2683	157.8	27.47	102.3	17.5	31.46	18.21
No. 4	1241	114	4354	889		445	2747	153.1	26.89	97.9	17.5	30.62	14.93
No. 4 ± No. 1							+ 64	− 4.2	−0.58	− 4.4	0	−0.84	−3.28
Percentage differences							+ 2	− 3	− 2	− 4	0	− 3	− 18

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration $48.28, No. 4 ration $45.36.

Difference in favor of No. 1 ration, $2.92.

Gain ($2.92), less extra cost ($0.58), gives net gain $2.34, daily net gain 1.45 cents.

69 DAYS ON NO. 1 RATION VS. 69 DAYS ON SAME

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Hominy feed	Milk	Butter	Money value of food	Cost of food for 100 lbs. milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
No. 1 I	289	184	2007	359	179		847	57.9	11.32	133.7	19.6	11.58	7.63
No. 1 II	362	101	2051	366	183		830	58.8	11.46	138.0	19.5	11.76	7.63
II ± I							− 17	+ 0.9	+0.14	+ 4.3	− 0.1	+0.18	0
Percentage differences							− 2	+ 2	+ 1	+ 3	− 1	+ 2	0

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration (I) $18.15, No. 1 ration (II) $18.30.

Difference in favor of II ration, $0.15.

Gain ($0.15), less extra cost ($0.14), gives net gain $0.01, daily net gain or loss 0.

69 DAYS ON NO. 4 RATION VS. 69 DAYS ON SAME

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Hominy feed	Milk	Butter	Money value of food	Cost of food for 100 lbs. milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
No. 4 I	415	276	2038	367		183	1013	53.7	13.12	129.5	24.4	10.74	7.03
No. 4 II	503	149	2043	368		183	1061	56.5	12.94	122.0	22.9	11.30	6.75
II ± I							+ 48	+ 2.8	−0.18	− 7.5	− 1.5	+0.56	−0.28
Percentage differences							+ 5	+ 5	− 1	− 6	− 6	+ 5	− 4

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 4 ration (I) $17.19, No. 4 ration (II) $17.65.

Difference in favor of II ration, $0.46.

Gain ($0.46), plus less cost ($0.18), gives net gain $0.64, daily net gain 0.93 cents.

RATIONS	Hay	Oat hay	Silage	Wheat bran	Gluten meal	Hominy feed	Milk	Butter	Money value of food	Cost of food for		Proceeds from butter at 20 cents	Fertilizing value of food eaten
										100 lbs. milk	1 lb. butter		
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	$	cts	cts	$	$

184 DAYS ON NO. 6 RATION VS. 184 DAYS ON SAME

No. 6	1526	428	5400	980	489		3069	185.0	35.15	114.5	19.0	37.00	21.97
No. 4	1193	784	5401	982		480	2961	177.8	32.96	111.3	18.5	35.56	19.18
No. 4 ± No. 6							— 108	— 7.2	—2.19	— 3.2	— 0.5	—1.44	—2.79
Percentage differences							— 4	— 4	— 6	— 3	— 3	— 4	— 13

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 6 ration $57.02, No. 4 ration $53.54.

Difference in favor of No. 6 ration, $3.48.

Gain ($3.48), less extra cost ($2.19), gives net gain $1.29, daily net gain 0.70 cents.

115 DAYS ON NO. 4 RATION VS. 115 DAYS ON SAME

No. 4 I	716	193	2737	613		306	1323	88.8	18.01	136.5	20.3	17.76	10.15
No. 4 II	802	120	2709	606		303	1252	86.1	17.92	143.3	20.8	17.22	10.03
II ± I							— 71	— 2.7	—0.09	+ 6.8	+ 0.5	—0.54	—0.12
Percentage differences							— 5	— 3	0	+ 5	+ 2	— 3	— 1

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 4 ration (I) $26.84, No. 4 ration (II) $26.08.

Difference in favor of I ration, $0.76.

Gain ($0.76), less extra cost ($0.09), gives net gain $0.67, daily net gain 0.58 cents.

115 DAYS ON NO. 1 RATION VS. 115 DAYS ON NO. 5 RATION

No. 1	683	442	3355	607	304		1556	92.7	20.73	133.5	22.4	18.54	14.19
No. 5	758	351	3298	303	303	303	1613	93.6	20.99	130.0	22.4	18.72	13.08
No. 5 ± No. 1							+ 57	+ 0.9	+0.26	— 3.5	0	+0.18	—1.11
Percentage differences							+ 4	+ 1	+ 1	— 3	0	+ 1	— 8

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration $30.73, No. 5 ration $30.26.

Difference in favor of No. 1 ration, $0.47.

Gain ($0.47), plus less cost ($0.26), gives net gain $0.73, daily net gain 0.64 cents.

RATIONS	Hay	Oat hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Hominy feed	Milk	Butter	Money value of food	Cost of food for		Proceeds from butter at 20 cents	Fertilizing value of food eaten
										100 lbs. milk	1 lb. butter		
	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	$	cts	cts	$	$
69 DAYS ON NO. 1 RATION VS. 69 DAYS ON SAME													
No. 1 I	439	283	2040	361	180		1216	68.3	12.64	103.8	20.0	12.66	8.58
No. 1 II	561	181	2042	366	183		1211	68.5	12.59	104.0	19.8	12.70	8.37
II ± I							— 5	+ 0.2	—0.05	+ 0.2	— 0.2	+0.04	—0.21
Percentage differences							0	0	0	0	— 1	0	— 2

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration (I) $20.51, No. 1 ration (II) $20.39.

Difference in favor of I ration, $0.12.

Gain ($0.12), less extra cost ($0.05), gives net gain $0.07, daily net gain 0.10 cents.

VI. EXPERIMENTAL ERROR

There yearly accumulates in the regular course of the feeding trials a large volume of data touching the experimental error involved in the alternation method of conducting feeding trials. To discuss it at length is unnecessary; but it seems worth while to place it upon permanent record.[1]

Twenty-five cows were fed unaltered rations throughout the course of the trials. If their records be treated as if they were fed different rations in alternate periods, a measure of the extent of experimental error is obtained. Old, middle-aged and young cows were included, fresh cows, cows in mid-lactation and those far along towards calving. Those fed the low and very low grain rations generally ate less dry matter than standards called for, but most of the others when judged by either standard ate plenty. But whatever the consumption, whether above or below standard amount, it was essentially uniform week in and week out.

RESULTS

At various points in the appendix, in Tables VI and VII, are data showing increase or decrease—expressed as percentages—in dry matter eaten, in milk, in total solids and fat given, and of product per 100 pounds of dry matter eaten, when unchanged rations were fed. It does not seem necessary to collate them at this point in one table, as has been done in previous reports. They exist in the appendix, albeit somewhat scattered. The results include 34 sets and 459 separate figures. These are distributed as follows: 75 zeros, 124 ones, 94 twos, 73 threes, 37 fours, 40 fives to sevens, 16 eights and higher. Eighty percent of the figures are threes or less, 1 percent are fives or higher. The average value is 2.32, a very poor showing.

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[1] Vt. Sta. Rpts. 3, pp. 62-64 (1889); 9, pp. 225-228 (1895); 10, pp. 165-167 (1897); 11, pp. 339-340 (1898); 12, pp. 286-287 (1899); 14, pp. 365-366 (1901); 15, pp. 314-316 (1902); 16, pp. 259-263 (1903).

Four of these 34 sets carry most of the bad and all of the very bad figures, and *are caused solely by the records of two cows*—Lady Perusia and Edith—neither of which ought to be included and both of which, because of their irregularities, were excluded from use in the feeding trials. Lady Perusia, coming in early in the third period and fed a very low ration, gave a large flow at the outset and fell off rapidly (674, 553, 540). Edith, far along in lactation, gave too little milk in the third period to make her record of use (312, 248, 135). The removal of these records makes the showing: 30 sets, 405 figures, including 69 zeros, 120 ones, 92 twos, 67 threes, 29 fours, 27 fives to sevens, and 1 eight. Over 86 percent of the figures are three or less, only 7 percent are fives or higher and the average value is 1.91, a fair showing, though not a good one.

Still further, 13 of the 29 fours and 13 of the 27 fives may be eliminated by the withdrawal of Elizabeth, Maid Marian and Flora, whose irregular flows are responsible respectively for 8, 9 and 9 of the high figures.

The records of each of these five cows were used alone. It has been abundantly proved in the past in the survey of this matter of experimental error that "in numbers there is strength." In fact there is only one case in the present year's trials in which two or more cows contribute to any set of data where more than one or two high figures are found. It should be remembered that the investigation of experimental error was subsidiary and that single animals, although they figure herein, were not used alone in the trials proper, which in no case included less than four and generally six or more cows per trial.

The record is an irregular one. *This is its merit rather than its defect*, for it the more clearly shows the danger of using only two or three animals in a feeding trial. Such results, obtained with single animals, do not throw doubt on the validity of data obtained when the selection of animals is made with care, when the number used is sufficient (never less than four and better twice that number) and feeding periods are from four to six weeks long.

VII. SUMMARY

The details given in the foregoing pages may be summarized as follows:

The nature of the problems studied.—Fifty-three cows were used in feeding trials, which lasted 25 weeks and were meant to determine so far as it is possible for single trials to do:

(*a*) The effect on the quantity and quality of milk and on the economy of production, of very low, low, and medium grain feeding; also the limit of profit in the use of grain—pages 470-484.

The feeding values of:

(*b*) Dried molasses beet pulp—pages 484-491.

(*c*) India wheat meal—pages 491-498.

(*d*) Hominy feed—pages 498-508.

(*e*) The extent of experimental error in feeding trials by the alternation method—pages 508-510.

Methods, details, etc.—The feeding periods were five weeks long and many different rations were used. Mixed hay, oat hay and corn silages were the roughages used. Full records were made, including weights of cows, fodders and feeds, milk, etc., barn temperatures were taken and constant analytical check was kept upon every phase of the work throughout the entire 25 weeks. These are in part exhibited on pages 467-469 and also in the appendix to this report.

Is 2 pounds of grain daily enough?—Fourteen cows were fed to determine whether a 2 pound grain ration proved as profitable as one of 4 or 8 pounds. The outcome was as follows:

Quantity.—The more grain, the more milk, total solids and fat. The gains averaged 8 percent when the 4 pound ration replaced the 2 pounds feed, and about 14 percent when the 8 pound one was used.

Economy of production.—A pound of dry matter made from 5 to 7 percent more milk, solids and fat on the very low ration than on the low, and from 8 to 13 percent more on the very low ration than on the medium ration.

Live weight.—About two-thirds of the cows responded to radical changes in the amount of grain fed by gaining flesh or losing it, according as feed was added or withdrawn. Those uniformly fed as a rule held their own.

Does it pay to feed as little as 2 pounds of grain daily?—When 2 pounds of grain were fed instead of 4, $4.02 were saved on grain bills and $1.28 lost in butter not made; when 2 pounds of grain were fed instead of 8, $7.57 were saved on grain bills and $3.02 lost in butter not made. When the skimmilk and manurial values are reckoned on, the figures are $4.02 and $3.33, $7.57 and $7.09.

These figures argue strongly for the restricted ration. They are opposed to those obtained in the preceding year and seem due to the high priced concentrates used and to the dairy abilities of the lightly fed cows. The writer's judgment, notwithstanding this outcome, does not approve a grain ration so very restricted in its nature.

Dried molasses beet pulp, pound for pound of dry matter, proved equivalent to wheat bran and likewise apparently equivalent to immature corn silage. At $12 it seems well worth trying. It is too costly at $20 (retail price at a Vermont point).

India wheat meal, used in small quantities, seems a fair substitute, pound for pound, of wheat bran, cottonseed and linseed meals, an outcome which analysis would not have led one to expect.

Hominy feed as a milk-maker equalled wheat bran, but was not the equal of cottonseed and linseed or gluten meals. In neither case at the ruling prices did it prove as economical a feed as did either of these byproducts.

Experimental error may safely be held to be almost nil when six to eight animals are used in the alternation method of trial.

A COMPARISON OF FEEDING TRIAL METHODS

(Fourth Article)

The data submitted herewith and the deductions drawn therefrom are the fourth contribution[1] of this Station to the study of this particular matter. The reasons for repetition, as well as the underlying motives which have prompted the pursuit of this particular line of inquiry have been discussed in previous issues and need no repetition at this time. The trials were made as in previous years with a view of noting the relative trustworthiness of two systems of measurement of the value of feeding rations for cows:

1. When the competing rations are fed to the same cows in successive periods in alternation, as for example, ration A to, say, 6 cows for five weeks (Period I); ration B to the same cows for the next five weeks (Period II); ration A to the same cows for the third five weeks (Period III); then ration B again and so on. This is denominated the simple alternation system.

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[1] For former articles see Vt. Sta. Rpts. 14, pp. 369-375 (1901); 15, pp. 318-327 (1902); 16, pp. 264-274 (1903).

2. When the competing rations are fed to two or three groups of cows; to one, in alternation as above outlined; to another, one of the rations fed continuously; and to the third, the other ration fed continuously. These groups are supposed to be chosen with care so that the cows enter the feeding trials in as nearly as may be an even condition, apparently capable of making as nearly as may be, cow for cow, the same quantities of milk and butter for some months to come if similarly fed and treated. The differences in milk and fat yields, as well as in many other items, which are actually observed, when divergencies in feeding are practiced with one of the groups, are held to be the measurements of food values by this method of comparison, which is known as that of combined continuity and alternation in feeding.

In planning the feeding trials for the seasons of 1903-04 it was designed to use both methods of measurements in all the trials. Fifty-six cows were chosen, the 28 constituting one group to be fed two rations in alternation and the 28 constituting a second group to be fed continuously a uniform ration. Thus these cows were paired in 28 couples,[1] every such couple having one cow from two of the above mentioned groups.

The original matches were made after a careful study of the records of performance of previous years, in some cases as far back as 1894, of stages of lactation, etc. An effort was made to link the records of cows which might be expected to yield during the course of the feeding trials approximately the same amounts of milk, of solids and of fat—more particularly the two latter—and as nearly as might be like solid and fat percentages, i. e. like qualities of milk. Thus, for example, Acme and Atalanta (table, page 514) were an ideal couple.

Naturally some matches were better than others. Also, and inevitably, some which promised well did less well than they promised, while in some cases the outcome proved better than was anticipated; and, as might be expected, considering the large number of animals involved and the vicissitudes of winter barn life, several of the original matches for one reason and another were rendered unserviceable. Temporary shrinkage preparatory to drying off ruined three couples, sales two, death one, feeding errors, etc., three, and five proved to have been poor matches. The failure of either member of a pair destroys the usefulness of both unless other mating can be made.

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[1] "Couple" is a term used to designate two cows thought to possess essentially the same milk and butter making abilities for the purposes of the experimental work in hand as outlined in the description of method 2.

Thus it happens that only 14 of the original 28 couples survived. Inasmuch, however, as each of the rations were fed to several cows, to some continuously and to some in alternation, it was possible, when the experiments were completed, to construct several other couples, using the actual rather than the anticipated records for this purpose. The records of one cow might serve thus as a basis for several comparisons. Hence there were made two sets of couples for purposes of calculation, those made in the fall before the test began, and those constructed after the trials were completed, using actual performance rather than anticipation as a guide in coupling, the total number being 49. Some of these were good ones, and some poor, or even bad. A large share of the secondary couplings proved better than the primary ones, hindsight being better than foresight.

A concrete case will serve to make this matter plain. The cow Surprise was judged before the trials began to be likely to give about as much milk, solids and fat as would the cow Una, if each were fed alike. Hence they were scheduled as a couple, and the former was fed continuously the beet pulp ration while the latter alternated between beet pulp and corn silage; and as a matter of fact this coupling was ideally good. When, however, the records of actual performance were scanned it was found that Adelaide, likewise alternating on pulp and silage, had made a record closely comparable with that of Surprise and hence a new coupling was made.

A careful survey of the records made in the first of three periods necessary to make a completed record for each cow, leads to the following classification of the 49 matches: Good 26, fair 5, indifferent 8, poor 10.[1]

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[1] Good, 1, 6, 8, 10-12, 16, 18, 20, 22, 24-26, 29, 30, 33, 35, 36, 44, 45, 47, 48, 52-54, 58. Fair, 5, 32, 38, 49, 56. Indifferent, 27, 34, 39, 40, 43, 46, 51, 57. Poor, 13-15, 17, 19, 21, 37, 41, 42, 50.

TABULATED STATEMENT SHOWING COWS USED IN COMPARATIVE TRIALS OF METHODS

NAME OF COW	Couple number and name of cow with which the first named cow is coupled	Age	Days since calving	Next calving, months	Period	Record during period indicated of cow named in first column.						Nature of rations fed to cow named in first column.
						Weight	Milk	Total solids	Fat	Total solids	Fat	
						lbs.	lbs.	%	%	lbs.	lbs.	
Acme	10 Atalanta	14	49		I	1008	747.5	12.03	3.53	89.90	26.41	No. 7
Acme	11 Atalanta		119		III	918	550.4	11.15	3.26	61.36	17.93	No. 7
Adelaide	14 Al., 16 Su.	10	235	9	I	958	346.7	15.43	5.66	53.48	19.61	Pulp (P. S.)
Adelaide	53 Juanita		270	8	II	948	296.2	15.13	5.52	44.81	16.36	Silage (S. P.)
Adelaide	17 Surprise		305	7	III	998	339.8	14.90	5.32	50.61	18.07	Pulp (P. S.)
Alta	14 Ad., 15 U.	7	250	8	I	833	422.9	15.06	5.35	63.70	22.61	Pulp
Atalanta	10 Acme	14	14		I	950	724.2	12.52	3.58	90.63	25.94	No. 7 (7-1)
Atalanta	11 Acme		84		III	940	523.7	11.91	3.38	62.35	17.70	No. 7 (7-1)
Beautina	1 Constance	12	172		I	895	297.6	14.60	5.13	43.47	15.28	Very low (1)
Beautina	52 Juanita		207		II	930	332.9	14.03	4.67	46.71	15.54	Med. (1)
Ceres	20 Sonoma	13	2		II	909	733.2	13.33	4.20	97.76	30.82	No. 3 (3-1)
Ceres	22 M. M., 43 Eu.		37		III	902	669.7	13.86	4.61	92.79	30.84	No. 1 (1-3)
Constance	1 Beautina	4	250	8	I	740	296.7	15.39	5.88	45.67	17.45	Very low (1)
Eleanor	44 Minta Bella	5	250		1	913	331.3	16.73	6.41	55.43	21.22	No. 1 (1-2)
Eleanor	27 Eva		285		II	913	291.9	16.52	6.26	48.22	18.26	No. 2 (2-1)
Eleanor	48 Elizabeth		320		III	903	315.9	16.29	6.09	51.46	19.24	No. 1 (1-2)
Elizabeth	12 S. C., 46 Ju.	3	30		I	800	406.2	15.87	5.94	64.46	24.12	No. 1
Elizabeth	47 Mermaid		65		II	797	331.5	15.94	6.11	52.84	20.24	No. 1
Elizabeth	(A)		100	9	III	786	321.3	15.77	5.88	50.65	18.90	No. 1
Eunice	41 Mo., 42 Po.	6	17		II	861	769.4	13.21	3.91	101.6	30.18	Med. (1)
Eunice	43 Ceres		52		III	860	672.7	13.44	4.06	90.40	27.28	Med. (1)
Eva	25 Mermaid	11	172		I	845	334.7	17.10	6.70	57.23	22.43	No. 2
Eva	27 Mermaid		207		II	868	311.8	16.99	6.75	52.98	21.06	No. 2
Eva	26 Mermaid		242	9	III	891	323.7	17.12	6.82	55.42	22.07	No. 2
Flora	29 Rosel	14	62		I	965	431.2	14.21	5.03	61.27	21.69	No. 4
Flora	30 Mayfair		132		III	940	327.4	13.18	4.37	43.16	14.29	No. 4
Fresno	34 Hallowe'en	5	96		III	873	415.2	13.14	4.09	54.57	16.99	No. 4 (4-6)
Haidee	40 Janice	7	282	6	I	1033	223.3	16.46	6.41	36.75	14.31	No. 5 (5-1)
Hallowe'en	33 Ro., 34 Fres.	10	50		III	880	400.7	14.35	5.05	57.49	20.22	No. 4
Janice	40 Haidee	7	128	8	I	898	263.3	15.58	5.55	41.02	14.61	No. 5
Jersey Lily	35 Star Bright	4	233		I	865	215.8	17.11	6.96	36.92	15.03	No. 4
Juanita	(B)	6	157		II	813	287.5	15.70	5.84	45.15	16.80	No. 1
Judith	46 Elizabeth	7	250	4	I	858	349.8	16.79	6.70	58.72	23.44	Med.(m.vl)(1)
Lavender	8 Ursula	6	192	7	III	965	323.5	14.96	5.58	48.38	18.06	Low (1)
Lizzie H.	36 Stephanie	4	250	7	I	900	439.3	14.60	4.89	64.15	21.50	No. 5 (5-1)
Lucerne	5 Stella	10	59		II	803	413.6	14.29	4.75	59.11	19.65	Very low (6)
Lucerne	6 Yuba		94	9	III	782	360.2	14.83	5.17	53.43	18.62	Very low (6)
Maid Marian.	50 Mo., 51 Po.	10	6		II	930	776.7	13.08	4.02	101.6	31.24	No. 1
Maid Marian.	22 Ceres		41		III	928	697.3	13.43	4.35	93.66	30.35	No. 1
Max Belle	24 Muriel	11	395		I	952	177.9	16.81	6.46	29.91	11.49	No. 3
Mayfair	32 Juanita	3	1		II	641	329.8	14.14	4.56	46.64	15.05	No. 1 (1-4)
Mayfair	30 Flora		36		III	653	308.7	14.08	4.49	43.48	13.85	No. 4 (4-1)
Mermaid	25 Eva	8	171	8	I	850	351.4	16.63	6.44	58.42	22.62	No. 2 (2-1)
Mermaid	27 Ev., 47 Eliz.		206	7	II	865	323.6	16.72	6.65	54.09	21.51	No. 1 (1-2)
Mermaid	26 Eva		241	6	III	880	311.1	17.01	6.72	52.91	20.91	No. 2 (2-1)
Minta Bella	44 El., 45 Yem.	12	180	5	I	805	340.9	16.17	6.30	55.12	21.48	Med. (1)
Mona	41 Eu., 50 May	6	0		II	975	625.1	14.37	5.05	89.80	31.56	No. 1 (1-7)
Muriel	24 Max Belle	3	347	8	I	695	158.5	16.75	6.66	26.55	10.56	No. 3 (3-1)
Nancy B.	56 Santa Rosa	15	119		I	1072	448.1	12.59	3.71	56.44	16.61	Silage (P. S.)
Nancy B.	57 Santa Rosa		189	8	III	1080	420.9	12.36	3.56	51.51	14.99	Silage (P. S.)
Pomona	42 Eu., 51 M. M.	12	15		II	810	652.8	14.14	4.84	92.27	31.61	No. 1 (1-4)
Rosel	29 Fl., 58 S. R.	7	100	8	I	1040	435.0	14.60	4.93	63.52	21.43	No. 4 (4-1)
Rosel	33 Hallowe'en		170	6	III	1031	370.6	14.45	4.97	53.56	18.42	No. 4 (4-1)

(A) 13 Santa Clara, 49 Yemassee, 48 Eleanor.
(B) 32 Mayfair, 52 Beatrice, 53 Adelaide, 54 Una.

NAME OF COW	Couple number and name of cow with which the first named cow is coupled	Age	Days since calving	Next calving, months	Period	Record during period indicated of cow named in first column.						Nature of rations fed to cow named in first column.
						Weight	Milk	Total solids	Fat	Total solids	Fat	
						lbs.	lbs.	%	%	lbs.	lbs.	
Rosemary ...	21 Sonoma	9	0		II	840	617.4	13.35	3.93	82.40	24.27	No. 3 (3-1)
Santa Clara..	12 Elizabeth	5	134		I	847	398.7	16.29	6.29	64.94	25.08	No. 1 (1-7)
Santa Clara..	13 Elizabeth	5	204		III	880	366.3	16.33	6.38	59.81	23.36	No. 1 (1-7)
Sonoma......	20 C. E., 21 Ry.	7	0		II	863	665.3	14.09	4.48	93.76	29.82	No. 3
Star Bright..	35 Jersey Lily		75		I	1092	218.7	16.83	6.64	36.81	14.51	No. 4 (4-6)
Stephanie....	36 Liz. Hexham	7	250	8	I	837	435.4	14.31	4.83	62.29	21.04	No. 5
Stephanie....	37 Yemassee		285	6	II	830	430.7	14.02	4.52	60.37	19.48	No. 5
Stella.........	5 Lucerne	6	36		II	831	485.0	13.32	4.08	64.61	19.77	Vl.(vl., m.) (6)
Surprise	16 Ad., 18 Una	4	174	8	I	767	359.8	15.89	5.81	57.17	20.93	Pulp
Surprise	17 Ad., 19 Una		244	6	III	808	354.5	16.26	6.06	57.64	21.48	Pulp
Una...........	15 Al., 18 Su.	4	201		I	770	351.6	15.46	5.80	54.37	20.38	Pulp (P. S.)
Una...........	54 Juanita		236	9	II	760	261.3	15.73	6.16	41.11	16.09	Silage (S. P.)
Una...........	19 Surprise		271	8	III	818	304.2	15.36	5.74	46.73	17.47	Silage (P. S.)
Ursula........	18 Lavender		158		III	994	353.4	14.60	5.23	51.60	18.49	Low(l.,vyl) (1)
Yemassee....	8 S. R., 45 Mi.	9	250	9	I	923	379.1	14.54	5.05	55.12	19.13	No. 1 (1-5)
Yemassee....	37 Stephanie		285	8	II	910	381.8	13.89	4.66	53.02	17.79	No. 5 (5-1)
Yemassee....	39 S. R., 49 Ez.		320	7	III	940	347.9	14.33	4.93	49.87	17.14	No. 1 (1-5)
Yuba..........	36 Lucerne	5	108	9	III	955	399.1	14.37	4.94	57.34	19.70	Vyl.(vyl.,l)(6)
Santa Rosa..	(C)	5	110		I	875	427.7	14.08	4.58	60.23	19.54	No. 1
Santa Rosa..	57 N. B., 39 Ye		180	9	III	896	403.0	13.71	4.36	55.27	17.59	No. 1

(C) 38 Yemassee, 56 Nancy B., 58 Rosel.

The plan of experimental feeding, the comparison with standards and the general results were discussed in the previous article. It simply remains to consider the final results as measured by the two methods of experimentation.

The article in the fourteenth report on this subject contained a table showing the percentage differences[1] in the dry matter consumption, in the quality of the milk, in the production of milk, total solids and fat and in the proportions of the same to the unit of dry matter. It showed this for both sets of cows, the animal first named in each case having been fed continuously on one ration and the one second named having been alternated between rations. It likewise gave the results following a change in the ration fed, as for instance a change from the low to the medium feeding. These form the measures of the value of the ration.

This table was omitted in the articles in the fifteenth and sixteenth reports, and will be again omitted now, for, if included, it would cover several pages solidly with figures. It is thought that it would be quite as well to give one example of the determination of the effect of the ration by the combined method and to deal in a later tabulation solely with the averages.

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[1] For further explanation of this phrase and of the meaning of the figures, see note on page 473 and explanatory note on Table VII at the end of the appendix.

TABULATED STATEMENT COMPARING THE TWO METHODS

Showing the increase or decrease, as the case may be, of the record of each cow in period II, as compared with the average of the records of periods I and III	Number of period of comparison	Total dry matter in entire ration	Total dry matter in experimental feed	Quantity of milk	Percentage of total solids	Percentage of fat	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
Jersey Lily, uniform feeding on No. 4 ration	II	—2	0	+1	0	—1	0	0	+8	+2	+2	+1	0	0
Star Bright, period II No. 6, and III No. 4	II	—2	+1	+4	—2	—4	+2	0	+7	+4	+2	+3	+1	—1
Results (±) of increase in ration as measured by Jersey Lily's record in comparison with Star Bright's		0	+1	+3	—2	—3	+2	0	+4	+2	0	+2	+1	—1

The following explanations may serve to make this table and its meaning more clear. The cows Jersey Lily and Star Bright, at the opening of the trials in December, gave promise of making much the same amounts of milk and butter, and of making milk of essentially uniform character during the next six months, provided they were similarly treated and fed. Jersey Lily was thus handled, being fed a uniform grain ration (No. 4) for 25 weeks. Star Bright, however, was not, since she alternated from the No. 4 to the No. 6 ration and back again. In the second period Jersey Lily made 1 percent more milk than she did on the average in the first and third periods of the unchanged ration. Star Bright made 4 percent more at the same time, due perhaps to her changed grain ration. It is assumed that her milk flow, like that of her mate's, would have increased only 1 percent had she, like her, been kept on the unchanged diet; that the same influences that caused Jersey Lily to increase but a single percent in her milk flow would have brought about no larger change with Star Bright; hence her positive 4 percent gain is equivalent to a 4—1 or 3 percent gain, in that being fed No. 6 she made 3 percent gain in addition to the 1 percent natural increase. Hence +3 (or 3 percent of the total which equals 100) is the measure, in this particular case, of the effect of the changed ration on the milk flow. All the other items, the quality of the milk, the pounds of total solids and fat, and the same proportioned to the unit of dry matter, are similarly calculated. These plus and minus changes, gains and losses, as a result of varying rations, are the measures of the worth of the two rations by the combined method of continuity and alternation.

These comparisons can only be made when the cow alternately fed varying rations eats the same one as her mate in the first and last period under comparison and the other ration in the intermediate period. This limits the number of observations to, at best, two for each couple and in the majority of cases to but one. Forty-nine comparisons only can be made, six in the trials of varying quantities and 43 in those of varying character of grain rations.

Now the question arises, how do these 49 results arrived at by the combined continuous-alternating method, compare with those obtained by the simple alternation system? The data secured by the latter method are given at sundry points in the appendix and in connection with the previous article. The following table shows them condensed and compared with those derived in the manner just indicated by the combined system. The horizontal lines marked "differences" serve to show what divergences occur:

Reference number	Method employed	Changes in rations	Couples used, i.e., couple numbers, see table, page 514	Number of observations or records	Total dry matter eaten	Dry matter in grain feed	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter					
												In total ration			In experimental feed		
												Milk	Total solids	Fat	Milk	Total solids	Fat
I	Cont.-alter.	vl. m.	1, 5	2	+29		+21	−1	−4	+21	+17	−6	−5	−9			
	Alternation	vl. m.		3	+26		+9	+2	+2	+11	+12	−13	−12	−11			
	Differences				3		12	3	6	10	5	7	7	2			
II	Cont.-alter.	m. vl.	46, 52	2	−28		−11	−2	−4	−12	−15	+15	+13	+9			
	Alternation	m. vl.		3	−28		−15	0	0	−15	−16	+10	+10	+10			
	Differences				0		4	2	4	3	1	5	3	1			
III	Cont.-alter.	vl. l.	6	1	+12		+7	−2	−4	+5	+4	−4	−6	−7			
	Alternation	vl. l.		3	+11		+4	0	−1	+4	+4	−6	−6	−6			
	Differences				1		3	2	3	1	0	2	0	1			
IV	Cont.-alter.	l. vl.	8	1	−10		−7	+2	+2	−5	−5	+3	+4	+5			
	Alternation	l. vl.		4	−11		−8	+2	+3	−7	−5	+4	+5	+6			
	Differences				1		1	0	1	2	0	1	1	1			
V	Cont.-alter.	Pu.Si.	14,15,16,17	6	−13	−40	−11	+1	+4	−10	−8	+3	+2	+5	+55	+57	+62
	Alternation	Pu.Si.	18, 19	5	−15	−37	−16	+2	+6	−15	−13	−1	−1	+2	+35	+39	+44
	Differences				2	3	5	1	2	5	5	4	3	3	20	18	18
VI	Cont.-alter.	Si.Pu.	53,54,56,57	4	+14	+56	+12	0	−1	+12	+11	−2	−1	−3	−26	−26	−26
	Alternation	Si.Pu.		4	+14	+53	+10	−2	−4	+10	+9	−3	−3	−6	−28	−29	−31
	Differences				0	3	2	2	3	2	2	1	2	3	2	3	5
VII	Cont.-alter.	1-2	44, 47, 48	3	−1	−4	−4	+1	+2	−3	−2	−4	−3	−2	0	+1	+2
	Alternation	1-2		4	−1	−3	−5	+1	+1	−4	−4	−4	−3	−3	−2	−1	0
	Differences				0	1	1	0	1	1	2	0	0	1	2	2	2
VIII	Cont.-alter.	2-1	25, 26, 27	3	+2	+3	+2	0	−1	+2	+2	+1	0	+1	−1	−2	−3
	Alternation	2-1		5	0	+4	0	0	+1	0	+1	0	0	+1	−4	−4	−3
	Differences				2	1	2	0	2	2	1	1	0	0	3	2	1
IX	Cont.-alter.	1-3	22, 43	2	−4	−1	+1	−2	−5	−1	−4	+3	+1	−2	+2	+1	−3
	Alternation	1-3		3	0	−1	−5	+1	+1	−2	0	−4	−2	0	−3	−1	+1
	Differences				4	0	6	3	6	1	4	7	3	2	5	2	4
X	Cont.-alter.	3-1	20, 21, 24	3	+3	−1	0	+1	+2	0	+2	−4	−2	−1	0	+1	+2
	Alternation	3-1		4	0	+1	−2	+1	+3	−2	−1	−3	−3	−1	−3	−3	−2
	Differences				3	2	2	0	1	2	3	1	1	0	3	4	4
XI	Cont.-alter.	1-4	32,42,51,58	4	+2	0	−1	−1	−2	−2	−2	−3	−4	−5	−1	−2	−3
	Alternation	1-4		3	+4	+1	+1	−3	−5	−2	−4	−3	−5	−8	0	−3	−6
	Differences				2	1	2	2	3	0	2	0	1	3	1	1	3
XII	Cont.-alter.	4-1	29, 30, 33	3	−2	0	0	+2	+2	+2	+3	+3	+5	+6	−1	+2	+2
	Alternation	4-1		4	−3	0	−4	+3	+6	−1	+2	−2	+1	+4	−4	−1	+2
	Differences				1	0	4	1	4	3	1	5	4	2	3	3	0
XIII	Cont.-alter.	1-5	38,39,45,49	4	−1	−1	+6	−3	−6	+3	0	+7	+4	+1	+7	+3	+1
	Alternation	1-5		2	−5	0	+3	−3	−5	0	−2	+6	+3	0	+3	0	−2
	Differences				4	1	3	0	1	3	2	1	1	1	4	3	3
XIV	Cont.-alter.	5-1	36, 37, 40	3	+1	−1	−2	+2	+3	0	+1	−3	−1	0	−1	+1	+2
	Alternation	5-1		3	−2	−1	−4	0	0	−3	−3	−2	−2	−2	−3	−2	−2
	Differences				3	0	2	2	3	3	4	1	1	2	2	3	4
XV	Cont.-alter.	1-7	12,13,41,50	4	0	+2	+3	+1	−2	+4	+1	+3	+4	+1	+2	+3	−1
	Alternation	1-7		4	0	+1	+1	0	−1	+1	−1	+1	+1	0	−1	−1	−2
	Differences				0	1	2	1	1	3	2	2	3	1	3	4	1
XVI	Cont.-alter.	7-1	10, 11	2	−7	−1	−4	−2	−1	−5	−4	−9	−9	−9	−3	−5	−3
	Alternation	7-1		4	−1	−1	−6	0	+2	−5	−3	−4	−4	−2	−4	−5	−2
	Differences				6	0	2	2	3	0	1	5	5	7	1	0	1
XVII	Cont.-alter.	4-6	34, 35	2	+1	0	+7	−2	−4	+6	+3	+7	+5	+2	+7	+6	+3
	Alternation	4-6		5	0	0	+3	0	0	+4	+4	+3	+4	+4	+3	+4	+4
	Differences				1	0	4	2	4	2	1	4	1	2	4	2	1

Seventeen comparisons were made, carrying 209 "difference figures." Naturally zeros and ones are all that can be desired, twos are quite satisfactory and indicate fair agreement, threes are somewhat wide, while fours and larger figures mean serious differences. All figures larger than three are shown in black face.

There appear 80 "differences" which are threes or larger, including 37 threes, 20 fours and 23 fives or larger figures. Expressing the relation by way of fractions:

Three-eighths of the entire number are threes and larger, one-fifth of the entire number are fours or larger, one-tenth of the entire number are fives or larger. Only five of the seventeen sets are altogether satisfactory, being Nos. III, IV, VII, VIII, XI. Five of those which betray discrepancies show between them only 7 fours and a single five and are, therefore, not really bad comparisons. Three others carry between them 9 fours and 2 fives, and, while bad, are not so very bad as to be rejected. Four (Nos. I, V, IX, XVI) are extremely bad.

Good—III, IV, VII, VIII, XI	5
Fair—VI, X, XIII, XIV, XV	5
Poor—II, XII, XVII	3
Bad—I, V, IX, XVI	4

Let us analyze the unsatisfactory data, attending to the small fry first:

VI. *One five*, caused by the very high fat content of the milk given by Una in fourth period on light silage feeding. She was stinted in her silage ration and she resented it.

X. *Two fours.*—Max Belle, continuously fed No. 3, left much oat hay uneaten during the last week in January. This lessened her consumption of dry matter by 8 percent, but not that of the experimental portion of the ration. Her milk yield shrunk 7 percent and the fat percentage went up 4 percent. The data at the extreme right of the line was naturally most affected by this irregularity.

XIII, XIV, XV. *One or two fours in each case*, and in each case due to fractions increasing to a four. The average is barely 3.5.

Turning now to the poor comparisons:

II. *Two fours and one five.*—A good illustration of the dangers of the combined method. Elizabeth and Judith, periods I and III vs. II; Elizabeth continuously fed No. 1 in medium amounts, Judith, fed No. 1 in medium, very low and in medium rations in successive periods. Judith tending to run dry by end of third period. Yields and quality: Elizabeth, 406, 332, 321; 15.87, 15.94, 15.77; 5.94, 6.11, 5.88. Judith, 350, 220, 182; 16.79, 16.49, 16.90; 6.70, 6.15, 6.25. The couple was judged at the outset to be at best an indifferent one; and Judith's 40 percent shrinkage in milk without coincident rise in quality, when compared with Elizabeth's 15 percent shrinkage and slight betterment in quality on an unchanged ration, afforded an anomalous result when the two were linked. Judith's data are of doubtful value when used in alternation; but its abnormalities are not emphasized as is the case when Elizabeth's are yoked therewith.

XII. *Three fours and a five.*—Two of these fours are high threes with fractions carried out. Hallowe'en, continuously fed No. 4, shrunk 12 percent in milk yield and increased the fat percentage 7 percent in the fourth period as compared with the average of the third and fifth. If couple 33, in which she figures, is rejected, the comparison is improved; but no good reason appears for rejecting it. No apparent cause for the shrinkage was observed.

XVII. *Four fours.*—Hallowe'en, true to name, again plays tricks here. Couple 34 (Hallowe'en, periods III and V vs. IV, continuously fed No. 4; Fresno, periods III and IV, fed No. 4, and period IV, fed No. 6), as did couple 33, from the irregular milk yield of the regularly fed cow. Fresno's record furnishes almost identical data, though variably fed, and Hallowe'en's, highly dissimilar figures despite her unchanged ration. The fraction appears here also, being responsible for two of the fours.

Taking up now the thoroughly bad ones, Nos. I, V, IX and XVI:

I. *Six out of nine figures 5 or above.*—It is easy to see what is at fault here; and the trouble lies, moreover, on the alternation side alone. The combined data is derived from couples 1 and 5, Constance-Beautina, Lucerne-Stella, while the alternation figures are a transcript of the records of Beautina, Stella and Serena. The latter cow does not figure on both sides of the comparison, as no coupling could be made which was passable. She shrank on passing from a very low to a medium ration more than she did on passing from the latter back again to the former (679, 551, 454 pounds milk), making a most anomalous record in this respect. She came in late, after the third period had begun in fact, and was at a disadvantage on this account. Her data is really misleading and harmful. If it is rejected a fair agreement is attained, 3 fours only being observed. These are due to the fact that both of the cows fed the unchanging diet shrank in yield, one 4 and the other 6 percent in the middle period, thus inflating some of the figures. Rejecting Serena's record, as it should be (and is in the discussion in another article on a previous page), comparison I is removed from the bad to the poor category.

V. *A four, 3 fives, 2 eighteens and 1 twenty.*—Here is a chamber of horrors! The combined data is based, moreover, on the largest bunch of couples yet gathered together; and the outcome is the worst thus far observed. Couples 14 to 19 were used, 16 and 18 being ideal couplings, while the remainder all figure in the "bad" lot. This is not the cause, however, for no matter what one or more is rejected the result is still an unhappy one. The difficulties here seem to be many. Surprise and Alta, regularly fed the pulp ration, made a minus record in the second period in the most intense cold weather of the winter. These records are each used twice and serve to lower the figures obtained by the combined method. Surprise was sick in the fourth period. If her record is used it plays havoc. If it is not used the situation is but little better. Una's light silage eating serves to make her difference figures at the extreme right very high, in the eighties in fact. They appear twice in the combined data, and but once in that obtained by simple alternation. And, finally, Nancy B., an aged Ayrshire, dropped only 3 percent in milk yield in the third period, when there was a 9 percent drop in total dry matter. Her low figures are used on one side and not on the other. In fact the data is so very divergent in each case that all attempts at determining adequate averages proved hopeless.

IX. *Three fours, 1 five, 2 sixes and 1 seven.*—No one cause seems to be operative here, several being responsible. Rosemary and Muriel, fed Nos. 1 and 3 in alternation, could not be mated with any other cows fed No. 1. They do not figure on the one side, while they carry two-thirds of the weight as to the figures on the other side. The two cows fed uniformly which were coupled with Ceres each show peculiarities of record. Eunice in the fourth period gave milk carrying three-fourths of a percent more solids and one half of a percent more fat than that she made in the third or fifth periods. Maid Marian's milk record for the third period was 697, 575 and 575 pounds. Neither of these eccentricities were what might have been expected of cows in the early stages of lactation eating heartily an unaltered ration. There may be other reasons for the situation, but these suffice to account for most of the discrepancies.

XVI. *Two fives, 1 six and 1 seven.*—The difficulty is easily found in this case. Couples 10 and 11 were used—Acme and Atalanta in each case. Acme is an aged Ayrshire. Her teeth failed her during the winter and she left much hay uneaten. Her method of feeding was uniform, but her consumption of hay irregular. Her dry matter consumption and milk yields were: Dry matter, 589, 528, 484, 408, 429; milk, 748, 703, 550, 402, 404. She lost a hundred pounds in weight during the winter. Obviously, such a record may well prove useless as an index of the effect of uniform feeding; and when it is thus used twice and is the only one thus used, it goes without saying that the outcome needs must be unsatisfactory.

How does the general result compare with those obtained in former years?

	Good to fair	Indifferent	Bad	Number of comparisons
1901	**Two-thirds**		one-third	4
1902	**One-half**	one-sixth	one-third	7
1903	**Two-fifths**	one-fourth	one-third	15
1904	**Three-fifths**	one-sixth	one-fourth	17

The period lengths were four weeks in the first two, and five weeks in the last two years. This year's results were based on a larger number of observations than ever before—49 in all, an average of nearly 3 to a comparison. Last year the average was but 2.2 to a comparison; in 1902, 2.1; and in 1901, 2.5. The outcome is rather better than those previously obtained. In five of the seven disagreements there were but two comparisons available on the combined side. In but one case (V), where there were four or more comparisons, were the results unsatisfactory. In other words, in proportion as data are scanty the possibilities of the disturbing effects of individuality are increased, a deduction quite in consonance with that hitherto made.

The writer, as he studies the data which accumulate year after year, becomes more fully convinced of the untrustworthiness of the combined method when it alone is used. The major part of the vagaries, inconsistencies, errors, etc., pertain to the figures thus derived. As has hitherto been shown, this means of measurement is open to many errors. The number of observations is apt to be curtailed, the individualities of two cows have to be dealt with instead of that of one, while any error in the record of one affects that of both. The results obtained by its use need close scrutiny before they are used as a basis for deduction. In other words, the combined system is cursed not only with the vices of the alternation system, but also with some which are peculiarly its own. The writer still believes in the use of both systems conjointly whenever possible, as the accuracy of the result is enhanced and one's faith therein increased if the two methods are essentially a unit in its declaration. When, however, they disagree, he believes that as a rule the alternation data is apt to be more reliable.

While it does not seem likely that material change in this position will result from future trials, it is expected to continue this comparison with a view of accumulating further data. Then, too, as has been just remarked, the regular feeding trials are the better therefor, since the attainment of agreeing results by radically different methods of experimentation lends weight to the deductions which may be drawn therefrom.

RECORD OF THE STATION HERD FOR 1903-1904

Hallowe'en, 1904, marked the end of a decade of continuous record taking with the station herd. The weights of milk given by each cow have been kept from the inception of the herd in June, 1888; and the weights and analyses of fodders and feeds eaten have always been made during the progress of feeding trials. The continuous record of food consumption the year round, whether on or off experiment, was not inaugurated, however, until the fall of 1894. These ten years' work have involved over a third of a million weights of milk, nearly a million weights of fodders, feeds, orts, cows, etc., and the taking of nearly 200,000 individual samples and about 25,000 composite samples of milk, and of about 5,000 samples of fodders, feeds, etc.

For ten years now, with a herd of from 30 to 50 animals, fed throughout the record year (and from one to two dozen or more either entering or leaving the herd yearly) the study of the production of milk and of butter and of the economy of this production has been pursued. The data have been yearly presented in the several reports, accompanied by more or less comment; and the same course is followed in the article now in hand. It has been in mind, however, from the beginning to digest this mass of data as opportunity offered when it arrived at large proportions. The commencement of such an attempt has been made which it is hoped may be presented in the near future.

It has been felt, however, that the periodical publication of the station herd record had another justification, that it served as a stimulus to dairymen. The Vermont station herd is unlike that owned by most of the colleges and stations. It is in its way *sui generis*. It is not a collection of registered animals, a lot of cows of various breeds chosen as types for classroom illustration. It is distinctively and almost entirely a farmer's herd. No fancy prices were paid for any of the stock. At no time have more than six or eight of the milking cows been registered or eligible to registry. As has been often said, the station herd is the creation of an individual farmer, a good judge of cattle, who built it up by careful breeding, selection, culling and judicious purchase (at prices above the average—but always paid for good cows—rarely exceeding $55, and in the long run, averaging practically $50). The underlying motive guiding the formation and handling of the herd has been to afford an object lesson in good modern dairy herd management, one which owes its succes not to high priced animals, to high feeding, to the governmental connection which the Station enjoys, or to any secret procedure, but simply to a good judgment based on experience, common sense and a fair knowledge of the laws of breeding, feeding and handling stock, an object lesson which any good New England dairy farmer may feel is not impossible for him to emulate, or even excel, as indeed many have done.

The records of the past two years have not been all that could be desired. The pasturage in 1903 was seriously damaged by the extreme drought of that spring. Immature corn was ensiled each year and a relatively poor silage fed, this being due to unfavorable weather during the growing seasons. And, finally, each winter a third of the cows were used in feeding trials which involved the use of very light grain rations, two to four pounds daily. In no case was a cow forced by high feeding. Eight pounds of grain daily with hay and silage containing but little mature corn was the maximum; a fair ration, but nothing out of the ordinary. Hence the relatively low records. The four matriarchs of the herd, Acme, Atalanta, Nancy B. and Flora, all of them in their day grand cows, sank below the 300 pound line and helped lower the average.

There are eight cows in the herd which have averaged for from three to nine consecutive years annual butter yields of from 414 to 370 pounds. This double quartette deserves some special recognition, which it is expected to accord them in an early publication. Their condensed record follows:

Ceres	in 7 consecutive years has averaged to make 414 pounds butter
Eva	in 6 consecutive years has averaged to make 413 pounds butter
Mermaid	in 4 consecutive years has averaged to make 396 pounds butter
Minta Bella	in 9 consecutive years has averaged to make 393 pounds butter
Rosel	in 4 consecutive years has averaged to make 386 pounds butter
Pomona	in 7 consecutive years has averaged to make 378 pounds butter
Sonoma	in 3 consecutive years has averaged to make 370 pounds butter
Inez	in 6 consecutive years has averaged to make 370 pounds butter

The records shown on the next few pages include for each cow the production of milk, total solids, fat and butter, the cost of the food eaten to the 100 pounds of milk and to the pound of fat and butter, the total cost of the food eaten, of the purchased grain, the net proceeds from butter sales—at the average price actually received during the year for butter—and the value of the fertilizing ingredients in the fodders and feed eaten.

The average production of milk and of butter for the entire herd during the last twelve years has been satisfactory and fairly uniform. The butter productions have been as follows: 1892, 335 pounds; 1893, 330 pounds; 1894, no record; 1895, 325 pounds; 1896, 324 pounds; 1897, 338 pounds; 1898, 313 pounds; 1899, 320 pounds; 1900, 357 pounds;

1901, 343 pounds; 1902, 308 pounds; 1903, 294 pounds; 1904, 298 pounds. The herd of 1892-93 contained about twenty cows and was slaughtered early in 1894 because of tuberculosis. The animals included in the present herd were bought at various times, from 1894 to 1904.

There were 78 cows in the herd within the limits of the record year,[1] but only 51 were members throughout the year.[2] Six of the cows not figuring in the main tabulation were heifers with their first calves, 2 were sold for beef, 1 died, and 14 were purchased during the fall. The records of the cows which did not finish their record year, or which began it after Nov. 1, 1903, have been kept as carefully as have those of the animals which completed the year. These broken records have not the value that pertains to complete data, yet, inasmuch as several of these cows figured in past records and many of them will figure in future ones, it is thought best to publish the figures.[3] They follow the main tabulations. Acme, Atalanta, Nancy B, Kimberley, and Zillah are registered Ayrshires; Beautina, Lady Perusia. Max Belle, Minta Bella, Linnet, Muriel, and Una are registered Jerseys. All other cows are high grade Jerseys. Many of the animals have higher records in past years than those given in the present tabulations.

The following remarks on pages 525-526 are explanatory of the record tables on the next four pages:

"*Pounds of milk*" are obtained by weighing each milking of each cow throughout the year.

"*Percent of fat*" is obtained by averaging by cross-division. Composite samples—eight or nine milkings each—are taken of the milk of each cow bi-monthly throughout the year and constantly while on feeding experiment.

"*Pounds of butter*" are obtained by adding the usual factor, *one-sixth*, to the pounds of fat. This is equivalent to a "surplus" of 16.7 percent. The conditions of our work (much sampling, varying methods of handling, frequent handling of relatively small quantities, etc.) are such that it is doubtful whether our average "surplus" is often thus high. Much cream and some milk are sold, and large amounts are taken as samples; hence our exact make *all as butter* cannot be stated. Conservative estimates of the butter values of these sold and sampled products, added to the known butter sales, when compared with calculations using the one-sixth factor, have in years past agreed within a narrow margin and show a surplus of 12 to 14 percent. It is manifestly unfair to charge against the cows these losses, which are to a considerable extent caused by the peculiar nature of our work and which do not obtain in ordinary dairy management.

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[1] Nov. 1 to Oct. 31 constitutes a record year.

[2] As a matter of fact several of these were sold before the record year was up. These had in practically all cases completed their milk yields for the record year.

[3] The data of a few cows which were sold in November and early December, 1903, are omitted.

"*Cost of food*" is reckoned from prices paid for grain, while hay is rated at $10, silage, soiling crops, etc., at $3, pasturage for the season at $5 per animal.

The average cost of food for 100 pounds of milk and for a pound of butter as stated in the table is obtained by dividing the total by 51, thus giving each cow the same value in the average, be her record good, bad or indifferent. *As a herd* the average cost of food for 100 pounds of *herd* milk and for a pound of butter were considerably less than is stated, being 95.8 and 16.2 cents respectively.

The figures showing "cost of 100 pounds of milk" and "cost of one pound of butter" include only the cost of food as laid down in barn ready for feeding. They do not include cost of feeding, caring for cows, making and marketing butter, depreciation of plant, interest on investment, etc. It is to be remarked, however, on the other hand, that many items other than those cited may be considered, in some degree at least, an offset against these expenditures and charges. Thus for example, it should be noted:

1. That "roughages" are rated as figures sufficiently liberal to more than cover the cost of raising and harvesting in normal seasons.

2. That the manurial constituents in the food fed at the barn are worth nearly half of its rated cost if these are reckoned at market prices for the same plant food of nearly if not quite the same availability as sold in the form of commercial fertilizers. There are also considerable amounts of plant food in the pasture grass eaten and thus transferred to the barn, which are not included in the schedule.

3. That the manurial constituents in the purchased grain were worth, when similarly rated, about three-fifths of its market price.

4. That a ton of butter removes less than a half dollar's worth of plant food from the farm.

5. That the increase of the herd and the sales of calves and cows are further items not considered above.

6. That the skimmilk and buttermilk from the 51 cows, at 20 cents per hundred (an absurdly low price as pork sells to-day), was worth in the vicinity of $475.

The herd on the whole made the most butter in 1899-1900, and made it most cheaply in 1895-96. Yet owing to the selling prices for butter, the financial showing of the past five years is better than that of former years.

RECORD OF THE HERD OF THE VERMONT AGRICULTURAL EXPERIMENT STATION FOR THE YEAR FROM NOV. 1, 1903, TO OCT. 31, 1904

Name	Age	Calved 1903	Calved 1904	Served 1904
Acme 5th 10842 A, R	14	Oct. 16		Feb. 15
Adelaide	10	Apr. 15	Sept. 25	
Alta	7	March	Aug. 5	
Atalanta 10777 A. R.	14	Nov. 20		March 2
Beautina 85928 A. J. C. C.	12	June 15	*April 19	June 18
Ceres	13	Jan. 7	Jan. 9	July 28
Constance	4	March	Aug. 10	Nov. 18
Edith	6	Jan. 26	Feb. 28	Oct. 2
Eleanor	5	March		May 1
Elizabeth	3	Nov. 4	Nov. 14	
Elsa	7	Sept. 7	Nov. 10	
Eunice	6	Dec. 21		July 27
Eva	11	June 15	Nov. 23	
Flora	14	Oct. 3		March 4
Fresno	5	Nov. 8		March 17
Haidee	7	Feb. 26	June 17	Sept. 22
Hallowe'en	10	Dec. 25		Aug. 7
Inez	11	Dec. 28		March 20
Janice	8	*July 30	Aug. 19	Nov. 24
Jersey Lily 2nd	4	April 16		March 24
Juanita	7	Aug. 5		Aug. 15
Judith	7	March	Feb, 25	Nov. 12
Lady Perusia 123228 A. J. C. C.	10	Nov. 24, '02	Feb. 15	
Lavender	6	Aug. 4	Sept. 11	
Linnet (Vt) 164653 A. J. C. C.	3	Jan. 28	Farrow	May 22
Lizzie Hexham	4	March	June 28	Nov. 9
Lucerne	10	Nov. 10	Nov. 1	
Maid Marian	12	July 2, '02	Jan. 2	May 19
Mermaid	8	June 16	Aug. 15	
Minta Bella 85578 A. J. C. C.	12	May 12	May 9	Nov. 25
Mona	7	*June 6, '02	Jan 13	July 26
Muriel (Vt.) 164652 A. J. C. C.	8	Dec. 21, '02	Aug. 22	
Nancy B 9581 A. R.	16	Aug. 7	Oct. 25	
Orpha	11	April 17	July 26	Sept. 19
Pomona	12	Dec. 23		Oct. 30
Queenie	3	Feb. 28	June 23	
Rosel	7	Aug. 26	Sept. 3	Nov. 18
Rosemary	9	Jan. 5	June 15	June 14
Santa Clara	5	July 23		
Santa Rosa	5	Aug. 16	Nov. 7	
Serena	7	Nov. 20, '02	Feb. 15	June 30
Sonoma	5	Jan. 11	Jan. 15	July 31
Star Bright	7	*Sept. 20, '02	Aug. 23	
Stella	6	Dec. 3		July 20
Stephanie	7	March	Aug. 22	
Surprise	4	June 15	Farrow	Nov. 16
Una (Vt.) 164651 A. J. C. C.	4	May 17	Oct. 31	
Ursula	8	Sept. 7	*Cct. 30	
Vivian	8	Sept. 6	Nov. 13	
Yemassee	9	March	Sept. 18	
Yuba	5	Oct. 27		Feb. 12
Cassandra	4		Sept. 1	
Chi	8		Sept. 1	Nov. 16
Epsilon	3		Sept. 1	
Fatima	2		Sept. 4	
Frances	7		Sept. 1	
Gamma	6		Sept. 11	
Irene	8	Feb. 6	Sept. 14	
Kimberley 15736 A. R.	4		Jan. 18	April 23
Laura	5	Nov. 2, '02	Sept. 17	
Max Belle 108996 A. J. C. C.	11	Feb. 16		Jan. 26
Max Ella	12			
Mayfair	3		Jan. 11	April 30
Mu	4		Sept. 19	
Myrtle	3		Oct. 11	
Rebecca	7		Sept. 20	
Sarnia	5		Sept. 20	
Sheila	3		Aug. 9	Nov. 15
Thoria	5		Sept. 22	
Valentine	2		Aug. 22	
Yttria	7		Sept. 23	
Zeta	6	*Aborted	Sept. 26	
Zillah 17639 A. R.	3		Aug. 4	Nov. 15
Zirconia	7		Oct. 3	

RECORD OF THE HERD OF THE VERMONT AGRICULTURAL EXPERIMENT STATION FOR THE YEAR FROM NOV. 1, 1903, TO OCT. 31, 1904

Name of cow	Days in milk.	Milk, lbs.	Total solids, percent	Fat, percent	Total solids, lbs.	Fat, lbs.	Butter, lbs.
Acme, 5th	328	7175	11.39	3.46	817.0	248.0	289.3
Adelaide	300	4121	15.09	5.54	621.8	228.4	266.5
Alta	324	5766	14.91	5.31	859.6	306.2	357.2
Atalanta	307	6372	12.36	3.44	787.6	219.4	256.0
Beautina	366	4517	14.23	5.00	642.7	225.9	263.6
Ceres	294	7065	14.19	4.97	1002.5	351.3	409.9
Constance	306	4460	14.51	5.05	647.0	225.4	263.0
Edith	328	6289	14.36	5.04	903.0	317.0	369.8
Eleanor	361	4777	16.12	6.15	769.9	294.0	343.0
Elizabeth	300	3953	15.91	6.09	629.0	240.7	280.8
Elsa	316	3533	14.76	5.58	521.3	197.0	229.8
Eunice	299	6284	13.83	4.55	868.8	285.7	333.2
Eva	316	4130	16.78	6.70	693.1	276.8	322.9
Flora	305	4444	14.03	4.73	623.5	210.2	245.2
Fresno	356	6460	13.43	4.11	867.8	265.5	309.8
Haidee	308	4489	14.71	5.47	660.3	245.6	286.5
Hallowe'en	334	4596	14.30	5.14	657.1	236.1	275.5
Inez	327	5925	15.00	5.62	889.0	333.1	388.6
Janice	297	3598	14.83	5.04	533.6	181.2	211.4
Jersey Lily 2nd	316	2524	16.61	6.69	419.2	168.9	197.0
Juanita	358	4115	15.72	5.97	646.9	245.7	286.6
Judith	335	5068	15.55	5.84	788.0	295.9	345.2
Lady Perusia	305	5754	14.95	5.62	860.3	323.4	377.3
Lavender	316	4726	14.76	5.34	697.8	252.4	294.5
Linnet	366	2821	16.39	6.55	462.3	184.8	215.6
Lizzie Hexham	301	5749	13.93	4.50	800.8	258.5	301.6
Lucerne	327	5284	14.57	5.13	769.6	270.9	316.0
Maid Marian	303	6695	13.77	4.68	921.7	313.0	365.2
Mermaid	338	4988	15.92	6.00	794.0	299.4	349.4
Minta Bella	339	5377	14.73	5.45	792.3	293.1	342.0
Mona	291	6248	14.19	4.97	886.8	310.3	362.0
Muriel	308	2481	15.94	6.17	395.5	153.0	178.5
Nancy B.	284	4685	12.50	3.83	587.9	179.4	209.3
Orpha	272	3486	13.47	4.31	469.6	150.4	175.5
Pomona	313	6166	14.10	5.04	869.1	310.9	362.7
Queenie	289	3279	14.58	5.10	478.1	167.1	195.0
Rosel	322	5723	14.41	4.83	824.4	276.4	322.5
Rosemary	287	5025	13.72	4.31	689.6	216.6	252.7
Santa Clara	305	4706	16.22	6.32	763.3	297.3	346.9
Santa Rosa	335	5165	14.38	4.78	742.9	247.0	288.2
Serena	325	5380	13.87	4.55	746.3	244.8	285.6
Sonoma	294	6668	14.20	4.82	946.9	321.1	374.6
Star Bright	290	3505	15.94	6.12	558.7	214.6	250.4
Stella	331	6276	13.99	4.53	877.9	284.5	331.9
Stephanie	324	5952	14.09	4.60	838.8	274.0	319.7
Surprise	366	5009	16.10	6.07	806.7	304.2	354.9
Una	335	3499	15.21	6.11	532.4	213.9	249.6
Ursula	358	5222	14.67	5.29	765.8	276.2	322.2
Vivian	350	5071	13.94	4.60	706.8	233.2	272.1
Yemassee	311	4968	14.14	4.83	702.4	239.7	279.6
Yuba	307	5336	14.45	5.00	770.8	266.8	311.3

The average record of the 51 cows which completed—or practically completed—the past record year was as follows:

Days in milk	319 days
Milk	5018 pounds
Total solids	14.42 percent
Fat	5.07 percent
Total solids	723.7 pounds
Fat	254.4 pounds
Butter	296.8 pounds

RECORD OF THE HERD OF THE VERMONT AGRICULTURAL EXPERIMENT STATION FOR THE YEAR FROM NOV. 1, 1903, TO OCT. 31, 1904

Name of cow	Cost of food	Cost of grain	Cost of food for 100 lbs. milk, cts.	Cost of food for 1 lb. fat, cts.	Cost of food for 1 lb. butter, cts.	Butter at 30 cts. a pound	Value of manurial ingredients
Acme 5th	$51.28	$24.29	71.5	20.7	17.7	$86.79	$31.08
Adelaide	48.93	25.42	118.3	21.4	18.4	79.95	28.92
Alta	52.26	31.00	90.6	17.1	14.6	107.16	29.94
Atalanta	49.49	21.61	77.7	22.6	19.3	76.80	29.94
Beautina	52.14	20.68	115.5	23.1	19.8	79.08	30.50
Ceres	50.75	19.88	71.8	14.4	12.4	122.97	28.09
Constance	41.11	11.75	92.2	18.2	15.6	78.90	22.95
Edith	50.79	20.80	80.8	16.0	13.7	110.94	29.78
Eleanor	55.52	24.84	116.2	18.9	16.2	102.90	31.60
Elizabeth	41.20	20.11	104.2	17.1	14.7	84.24	24.26
Elsa	40.92	12.99	115.8	20.8	17.8	68.94	23.20
Eunice	48.60	17.99	77.3	17.0	14.6	99.96	28.67
Eva	49.41	22.42	119.6	17.9	15.3	96.87	26.28
Flora	47.15	20.24	106.1	22.4	19.2	73.56	25.34
Fresno	54.72	23.57	84.7	20.6	17.7	92.94	30.67
Haidee	50.87	23.02	113.4	20.7	17.8	85.95	29.41
Hallowe'en	47.93	18.79	104.3	20.3	17.4	82.65	24.80
Inez	50.03	19.22	84.4	15.0	12.9	116.58	27.91
Janice	45.85	23.49	127.4	25.3	21.7	63.42	23.02
Jersey Lily 2nd..	40.20	19.41	159.3	23.8	20.4	59.10	18.58
Juanita	50.54	24.72	122.8	20.6	17.6	85.98	29.78
Judith	45.26	18.90	89.3	15.3	13.1	103.56	25.90
Lady Perusia	43.29	11.18	75.2	13.4	11.5	113.19	23.54
Lavender	48.18	15.02	102.0	19.1	16.4	88.35	27.06
Linnet	40.99	18.77	145.3	22.2	19.0	64.68	22.11
Lizzie Hexham ..	49.97	23.78	86.9	19.3	16.6	90.48	28.86
Lucerne	46.60	12.29	88.2	17.2	14.7	84.80	25.45
Maid Marian	49.98	19.33	74.7	16.0	13.7	109.56	29.36
Mermaid	54.63	23.85	109.6	18.3	15.6	104.82	29.59
Minta Bella	50.42	20.27	93.8	17.2	14.7	102.60	29.50
Mona	48.29	17.81	77.3	15.6	13.3	108.60	24.87
Muriel	39.74	18.28	160.2	26.0	22.2	53.55	18.89
Nancy B.	50.86	28.39	108.6	28.4	24.3	62.79	31.33
Orpha	46.40	20.10	133.1	30.9	26.4	52.65	27.27
Pomona	48.78	19.60	79.1	15.7	13.5	108.81	27.25
Queenie	36.64	13.99	111.7	21.9	18.8	58.50	18.71
Rosel	53.64	26.27	93.7	19.4	16.6	96.75	29.97
Rosemary	50.42	19.23	100.3	23.3	19.9	75.81	28.00
Santa Clara	44.59	20.24	94.7	15.0	12.9	104.07	22.99
Santa Rosa	52.42	21.79	101.5	21.2	18.2	86.46	31.64
Serena	48.99	17.67	91.0	20.0	17.2	85.68	27.48
Sonoma	50.47	20.49	75.7	15.7	13.5	112.38	27.13
Star Bright	50.63	22.39	144.5	23.6	20.2	75.12	27.95
Stella	47.71	17.01	76.0	16.8	14.4	99.57	26.78
Stephanie	52.92	23.79	88.9	19.3	16.5	95.91	29.99
Surprise	52.42	34.46	104.6	17.2	14.8	106.47	31.30
Una	44.83	26.39	128.1	21.0	18.0	74.88	24.28
Ursula	49.59	15.34	95.0	18.0	15.4	96.66	28.35
Vivian	41.15	11.72	81.1	17.6	15.1	81.63	23.06
Yemassee	51.22	23.69	113.1	21.4	18.3	83.88	29.65
Yuba	42.39	10.76	79.4	15.9	13.6	93.39	24.05

Cost of food..............................	$48.11
Cost of purchased grain.....................	$20.37
Cost of food per 100 pounds milk............	101.1 cents
Cost of food per 1 pound fat...............	19.5 cents
Cost of food per 1 pound butter..............	16.7 cents
Proceeds from butter sales at 30 cents........	$89.05
Value of manurial ingredients...............	$27.00

RECORD OF THE HERD OF THE VERMONT AGRICULTURAL EXPERIMENT STATION FOR THE YEAR FROM NOV. 1, 1903, TO OCT. 31, 1904

Name of cow	Days in milk	Milk, lbs.	Total solids, percent	Fat, percent	Total solids, lbs.	Fat, lbs.	Butter, lbs.
Cassandra	52	1127	14.75	5.10	166.2	57.5	67.1
Chi	52	1034	13.70	4.45	141.6	46.0	53.7
Epsilon	52	786	13.85	4.20	108.8	33.0	38.5
Fatima	56	687	14.63	5.00	100.6	34.4	40.1
Frances	52	935	14.55	5.00	136.0	46.7	54.5
Gamma	49	987	14.60	5.40	144.2	53.3	62.2
Irene	46	1061	12.60	3.85	133.7	40.9	47.7
Kimberley	254	4688	12.22	3.77	573.0	176.6	206.0
Laura	43	1028	14.00	4.70	144.0	48.3	56.3
Max Belle	222	1652	16.54	6.36	273.3	105.0	122.5
Max Ella	98	1147	14.04	4.62	161.0	53.0	61.8
Mayfair	286	3133	13.98	5.05	437.9	158.1	184.5
Mu	42	914	13.80	4.60	126.2	42.1	49.1
Myrtle	19	341	13.60	4.00	46.4	13.6	15.9
Rebecca	41	1074	13.15	4.05	141.3	43.5	50.7
Sarnia	41	807	13.15	3.90	106.1	31.5	36.7
Sheila	81	1243	13.88	4.63	172.5	57.4	67.0
Thora	39	895	14.20	4.80	127.1	43.0	50.2
Valentine	68	1131	14.50	4.90	164.0	55.4	64.6
Yttria	37	960	12.90	3.80	123.8	36.5	42.6
Zeta	34	798	14.10	4.55	112.6	36.3	42.3
Zillah	86	1788	13.27	4.10	237.3	73.3	85.5
Zirconia	26	573	14.10	4.65	80.8	26.7	31.1

Name of cow	Cost of food	Cost of grain	Cost of food for			Butter at 30 cts. a pound	Value of manurial ingredients
			100 lbs. milk	1 lb. fat	1 lb. butter		
	$	$	cts.	cts.	cts.	$	$
Cassandra	6.76	3.42	60.0	11.7	10.1	20.13	3.25
Chi	7.50	3.63	72.5	16.3	14.0	16.11	3.70
Epsilon	6.16	2.77	78.4	18.7	16.0	11.55	2.93
Fatima	6.33	2.85	92.1	18.4	15.8	12.03	3.14
Frances	7.47	3.64	79.9	16.0	13.7	16.35	3.68
Gamma	7.31	3.54	74.1	13.7	11.8	18.66	3.58
Irene	7.45	3.54	70.2	18.2	15.6	14.31	3.69
Kimberley	41.21	17.15	90.0	23.9	20.5	61.80	21.31
Laura	7.11	3.23	69.2	14.7	12.6	16.89	3.54
Max Belle	41.69	21.56	252.4	39.7	34.0	36.75	25.03
Max Ella	17.67	8.33	154.0	33.3	28.6	18.54	10.86
Mayfair	31.54	13.51	100.7	19.9	17.1	55.35	13.82
Mu	6.98	3.11	76.4	16.6	14.2	14.73	3.50
Myrtle	3.00	1.15	88.0	22.1	18.5	4.77	1.35
Rebecca	6.90	3.08	62.4	15.9	13.6	15.21	3.75
Sarnia	6.95	3.08	86.1	22.1	18.9	11.01	3.81
Sheila	9.22	4.10	74.2	16.1	13.8	20.10	4.86
Thoria	6.60	3.04	73.7	15.4	13.1	15.06	3.28
Valentine	8.04	3.78	71.1	14.5	12.4	19.38	3.88
Yttria	6.58	3.04	68.5	18.0	15.4	12.78	3.27
Zeta	6.41	2.86	80.3	17.7	16.2	12.69	3.16
Zillah	10.74	5.06	60.1	14.7	12.6	25.65	5.36
Zirconia	5.88	2.33	102.6	22.0	18.9	9.33	2.87

The following tables show the extremes of quantity, quality, cost of production, etc., during the year:

EXTREMES OF PRODUCTION

	Lowest amount for any cow		Highest amount for any cow	
Pounds of milk	2811	Muriel	7175	Acme
Percent of total solids	11.39	Acme 5th	16.78	Eva
Percent of fat	3.44	Atalanta	6.70	Eva
Pounds of total solids	395.5	Muriel	1002.5	Ceres
Pounds of fat	150.4	Orpha	351.3	Ceres
Pounds of butter	175.5	Orpha	409.9	Ceres
Cost of feed	$39.74	Muriel	$55.52	Eleanor
Cost of grain	$18.28	Muriel	$31.00	Alta
Cost of 100 pounds of milk	71.5c	Acme	160.2 c.	Jersey Lily 2d
Cost of 1 pound of fat	13.4c	Lady Perusia	30.9 c.	Orpha
Cost of 1 pound of butter	11.3c	Lady Perusia	26.4 c.	Orpha
Value of butter at actual selling price	$52.65	Orpha	$122.97	Eva
Value of fertilizing ingredients in food	$18.38	Jersey Lily 2d	$31.64	Santa Rosa

The usual wide extremes are found. The record as a whole is a relatively poor one.

The following table shows the feeding record of each cow which was a member of the herd within the record year. All of the cows were out to pasture for about five and one-half months, but were housed over night. They were fed twice daily the year around except for a short time in the flush of the pasture season, grained during the summer to some extent, watered in winter twice a day, and turned out in the winter for from 20 to 40 minutes daily, except in extreme weather. The Station herd is used in feeding experiments from December to June, during which time the cows are subjected to many changes in ration. In some cases materials may be fed which are distasteful, and sometimes wasteful or ill-balanced rations are designedly used. These changes, necessitated by the conduct of feeding experiments, are obviously not conducive to maximum production. At no time was special effort made to select or to feed the most economical ration, or to force any cow to her utmost. The average grain feed ration is far from a maximum one and by many would not be deemed liberal feeding. More grain would have meant more milk, more butter, more dollars, but perhaps not more net profit.

FEEDING RECORD

Name of cow	Hay	Oat hay	Rowen hay	Green rowen	Corn silage	Apple pomace	Wheat bran	Corn meal	Cottonseed and linseed meals	Hominy meal	India wheat	Gluten meal	Molasses beet pulp
Acme,	1146	498	392	797	7065	....	962	122	650	11	...	56	580
Adelaide,	2085	...	400	239	3811	....	1249	101	513	11	...	33	724
Alta,	2030	...	390	879	1888	....	1315	201	488	...	...	28	1450
Atalanta,	1316	584	395	797	6797	....	1024	95	573	11	...	18	356
Beautina,	1606	671	399	845	7858	....	1229	234	379	11	...	40	11
Cassandra	186	6	...	258	663	...	222	112	...	...	...	...	....
Ceres,	1627	679	406	903	6535	760	978	181	362	11	185	5	11
Chi,	210	8	...	346	832	....	235	119	...	...	...	...	....

Name of cow	Hay	Oat hay	Rowen hay	Green rowen	Corn silage	Apple pomace	Wheat bran	Corn meal	Cottonseed and linseed meals	Hominy meal	India wheat	Gluten meal	Molasses beet pulp
Constance,	1581	575	373	883	6921	....	688	200	171	...	...	28	....
Edith,	1828	561	396	894	6139	340	1244	223	392	11	...	33	11
Eleanor,	1522	664	402	883	7609	....	1469	206	335	11	182	33	11
Elizabeth,	956	442	194	352	4726	....	1176	68	518	11	...	31	11
Elsa,	1329	620	398	546	6924	....	757	83	57	11	...	266	11
Epsilon,	189	6	...	246	663	....	179	90	...	...	...	...	....
Eunice,	1593	656	401	884	6258	1056	1105	103	412	11	...	5	11
Eva,	1336	606	390	550	6997	....	1244	94	77	11	469	40	11
Fatima,	160	6	...	442	663	....	184	93	...	...	...	...	....
Flora,	1253	566	390	359	6877	....	1256	70	71	477	...	61	11
Frances,	205	8	...	344	832	....	235	119	...	...	...	...	....
Fresno,	1578	653	397	889	7775	....	1468	206	47	291	...	216	11
Gamma,	193	8	...	344	832	....	230	116	...	...	...	...	....
Haidee,	1310	600	395	909	6632	....	1165	235	438	197	...	41	11
Hallowe'en,	2031	8	398	896	6406	651	1238	181	...	410	...	5	11
Inez,	1608	686	404	892	6622	697	1229	181	...	196	...	215	11
Irene,	210	8	...	355	832	....	230	116	...	...	...	...	....
Janice,	966	406	278	813	5264	....	894	169	508	450	...	44	....
Jersey Lily 2nd,	889	413	257	539	4782	....	1219	65	55	477	...	48	11
Juanita,	1063	388	286	873	7214	....	1484	221	510	11	...	32	11
Judith,	2102	49	384	899	4747	125	1138	219	337	11	...	31	11
Kimberley,	2006	481	402	229	1439	930	1121	474	33	99	...	...	....
Lady Perusia,	2157	486	398	895	5538	1500	684	216	44	11	...	92	11
Laura,	209	8	...	358	832	....	210	106	...	...	...	...	....
Lavender,	2871	8	393	523	7343	....	873	158	292	11	...	33	10
Linnet,	1073	395	234	744	5399	....	1092	150	185	8	204	35	9
Lizzie Hexham,	1339	492	275	897	6199	....	1164	215	473	219	...	59	10
Lucerne,	2902	16	396	898	7589	....	750	202	41	11	...	140	11
Maid Marian,	1597	650	403	896	6724	640	1200	181	381	11	...	5	11
Max Belle,	1330	558	387	...	5833	....	609	26	520	...	461	44	....
Max Ella,	428	325	321	...	2642	....	380	26	223	...	...	44	95
Mayfair,	906	261	...	767	4015	....	858	135	135	146	...	4	9
Mermaid,	2238	8	402	902	7458	....	1364	172	253	...	281	45	....
Minta Bella,	1827	579	399	893	6067	439	1213	222	378	11	...	33	11
Mona,	1562	598	405	922	6714	803	959	181	353	11	...	5	213
Mu,	208	8	...	358	832	....	202	101	...	...	...	...	....
Muriel,	984	308	323	555	5032	....	795	123	385	...	206	31	....
Myrtle,	145	...	...	...	405	....	75	38	...	...	...	...	....
Nancy B.,	1112	323	388	710	4852	....	1404	63	649	11	...	38	710
Orpha,	1260	572	393	881	5903	....	887	225	440	...	...	36	368
Pomona,	2036	13	396	874	6386	699	1248	181	221	196	...	5	11
Queenie,	1314	393	262	799	3964	440	817	216	45	8	156	25	9
Rho,	197	8	....	360	832	....	199	101	...	...	...	...	....
Rosel,	1655	8	396	534	7513	....	1602	159	294	359	...	49	10
Rosemary,	2193	13	397	915	6987	870	972	181	347	11	161	5	11
Santa Clara,	905	396	283	539	7076	....	1063	83	...	11	...	554	194
Santa Rosa,	1548	549	396	985	7780	....	1289	114	521	11	...	33	11
Sarnia,	208	8	...	361	831	....	199	101	...	...	...	...	....
Serena,	1972	509	397	886	5570	1475	1258	216	43	11	...	161	11
Sheila,	178	11	...	778	678	....	266	134	...	...	...	...	....
Sonoma,	1570	624	388	901	6285	845	788	181	350	11	349	5	11
Star Bright,	1471	630	384	685	6510	....	1375	226	26	278	...	215	....
Stella,	2234	8	398	899	7425	....	1068	181	...	11	...	317	11
Stephanie,	1522	539	380	681	7274	....	884	172	524	451	...	52	....
Surprise,	1088	339	265	868	2116	....	1475	223	508	11	...	33	1618
Thoria,	182	6	...	341	738	....	197	99	...	...	...	...	....
Una,	970	429	278	353	3011	....	1206	77	513	11	...	29	1008
Ursula,	2788	13	443	903	7782	....	912	199	251	11	...	36	11
Valentine,	173	6	...	579	663	....	245	123	...	...	...	...	....
Vivian,	1467	542	284	878	7763	....	683	91	56	11	...	221	11
Yemassee,	1440	510	294	215	7318	....	1180	145	532	194	...	59	11
Yttria,	178	6	...	342	738	....	197	99	...	...	...	...	....
Yuba,	1859	832	401	359	7080	....	622	82	59	11	...	199	11
Zeta,	176	6	...	348	738	....	185	93	...	...	...	...	....
Zillah,	174	11	...	809	692	....	328	165	...	...	...	...	....
Zirconia,	176	6	...	350	738	....	151	76	...	...	...	...	....

APPENDIX

RESULTS OF PURITY AND GERMINATION TESTS OF SAMPLES OF GRASS AND FORAGE PLANT SEEDS

Collected during the spring of 1903 by the Vermont Agricultural Experiment Station and tested by the Seed Laboratory, United States Department of Agriculture, together with prices paid and actual cost of pure seed that will grow. (The "actual value" is the percentage of pure seed in the sample *that will grow* and is obtained by multiplying the percentage of purity by the percentage of germination.)

(TABLES PREPARED BY EDGAR BROWN, BOTANIST IN CHARGE OF SEED LABORATORY, U. S. DEPT. AGR.)

REDTOP (*Agrostis alba*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
18658	18.	4.	78.	91.25	71.18
18659	17.6	20.9	61.5	88.5	54.48
18663	9.3	.6	90.1	70.25	63.33
18664	11.8	.7	87.5	69.75	61.03
18704	6.	1.2	92.8	93.5	86.77
18705	7.7	10.	82.3	93.5	76.95
18706	11.3	8.2	80.5	93.	74.87
18707	8.	7.7	84.3	90.75	76.52
18708	19.1	24.	56.9	73.75	41.97
18709	8.8	1.7	89.5	89.5	80.1
18710	8.4	42.	49.6	93.	46.14
18781	3.	1.	96.	98.75	94.8
18782	5.2	2.5	92.3	54.5	50.31
18783	11.2	13.7	75.1	45.	33.8
18784	16.	8.1	75.9	57.5	43.65
18793	61.	11.5	27.5	81.5	22.41
18794	2.9	20.	77.1	92.5	71.32
18795	6.2	11.8	82.	90.5	74.21
18796	8.	.8	91.2	90.5	82.54
18797	11.2	1.	87.8	69.	60.58
18825	3.9	.5	95.6	97.5	93.2
18826	3.	2.1	94.9	97.5	92.54
18827	6.5	11.8	81.7	91.	74.35
18828	2.7	1.8	95.5	92.	87.87
18847	5.1	44.95	49.95	88.5	44.21
18901	6.2	1.6	92.2	90.5	83.45
18902	14.4	3.	82.6	87.5	72.28
18903	10.98	11.57	77.45	93.5	72.43
18972	53.2	24.5	22.3	88.5	19.74
18973	26.	.9	73.1	89.	65.6
18975	4.2	.7	95.1	92.5	87.98
18976	6.	6.	88.	90.5	79.65
18977	9.68	16.96	73.36	91.5	67.13
18978	9.2	1.1	89.7	70.5	63.25
18979	2.95	2.06	94.99	90.	85.51
18994	12.2	5.7	82.1	89.	73.09
18995	9.7	10.6	79.7	87.	69.35
18996	8.	10.5	81.5	90.5	73.77
18997	27.17	7.04	65.79	91.5	60.2
18998	6.	23.2	70.8	82.5	58.44
18999	2.88	1.06	96.06	92.	88.37
19043	24.23	.96	74.81	97.5	72.96
19044	17.24	23.02	59.74	91.5	54.66
19045	11.68	2.98	85.34	91.	77.66
19046	2.55	16.81	80.64	97.5	78.65
19047	3.18	20.47	76.35	92.5	70.63
19048	5.76	1.56	92.68	96.	88.98
19049	4.78	1.07	94.15	91.5	86.13
19116	17.17	20.46	62.37	90.5	56.46
19117	13.21	3.81	82.98	90.5	75.14
19118	3.65	2.02	94.33	93.5	88.22

REDTOP (*Agrostis alba*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
19119	2.85	1.18	95.97	88.5	84.94
19120	16.7	18.1	65.2	84.5	55.1
19121	5.58	8.8	85.62	95.5	81.77
19122	11.5	5.2	83.3	89.	74.14
19147	1.38	.39	98.23	90.	88.42
19148	7.09	12.86	80.05	92.5	74.04
19149	5.56	8.68	85.66	96.5	82.66
19150	8.18	3.17	88.65	53.5	47.43
19166	30.7	1.2	68.1	74.5	50.75
19167	7.77	11.7	80.53	88.	70.86
19168	6.86	10.97	82.17	90.5	74.37
19169	19.98	.7	79.32	93.5	74.17
19170	3.02	.49	96.49	96.5	93.11
19188	2.8	22.5	74.7	90.	67.24
19189	10.	21.75	68.25	91.5	62.45
19211	21.49	3.87	74.64	87.	64.94
19212	16.91	18.47	64.62	67.5	43.62
19213	13.41	7.29	79.3	91.5	72.57
19214	3.13	22.97	73.9	89.5	66.15
19256	12.96	4.94	82.1	81.5	66.92
19257	4.96	2.39	92.65	89.5	82.93
19284	3.3	14.43	82.27	98.5	81.04
19285	3.54	.29	96.17	97.5	93.77
19286	.8	22.5	76.7	43.	32.98
19307	8.37	11.38	80.25	89.	71.31
19311	14.06	2.36	83.58	97.	81.07
19312	20.5	21.8	57.7	93.5	53.95
19313	8.5	5.4	86.1	93.	80.07
19314	5.	46.5	48.5	98.	47.53
19336	3.7	1.	95.3	98.	93.39
19337	6.5	7.	86.5	93.	80.88
19338	.48	.29	99.23	96.5	95.76

RAPE (*Brassica napus*)

19232	2.4	3.6	94.	98.5	92.61

GERMAN MILLET (*Chaetochloa italica*)

18837	.73	.53	98.74	91.5	90.35
18862	7.23	1.5	91.27	85.5	78.02
18935	1.6	.93	97.47	90.	87.76
19062	.53	.63	98.84	85.	84.03
19104	.66	.16	99.18	93.	92.25
19186	1.26	.8	97.94	76.5	74.92
19322	.33	.93	98.74	92.5	91.33

GOLDEN MILLET (*Chaetochloa italica*)

18933	.1	.43	99.47	91.	90.52
19061	.87	1.	98.13	97.	95.21
19340	3.17	1.03	95.8	93.5	89.57

HUNGARIAN MILLET (*Chaetochloa italica*)

18661	.5	.16	99.34	67.5	67.06
18703	3.7	3.68	92.62	81.75	75.72
18738	2.98	3.04	93.98	82.	77.08
18739	1.84	1.22	96.94	90.	87.26
18740	4.62	3.26	92.12	77.	70.93
18741	3.7	4.3	92.	81.75	75.21
18787	1.07	4.23	94.7	87.	82.38
18789	1.56	1.56	96.88	87.5	84.76
18788	2.23	.3	97.47	87.5	85.28
18790	2.5	.63	96.87	92.	89.12
18791	.27	.8	98.93	96.5	95.48

HUNGARIAN MILLET (*Chaetochloa italica*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
18838	1.16	1.16	97.68	80.	78.14
18839	3.36	1.6	95.04	67.5	64.15
18840	.46	3.23	96.31	77.	74.16
18863	.53	4.37	95.1	93.	88.46
18864	.63	2.4	96.97	85.	82.43
18904	.56	.7	98.74	89.	87.9
18905	1.4	3.47	95.13	91.5	87.05
18906	2.	1.8	96.2	89.5	86.11
18930	5.8	.5	93.7	95.5	89.48
18931	.6	.93	98.47	85.	83.72
18932	1.33	3.23	95.44	90.	85.9
18969	1.2	4.56	94.24	85.25	82.08
18970	1.6	3.1	95.3	82.75	78.86
18971	.36	.96	98.68	88.75	87.58
19035	.16	1.86	97.98	89.	87.22
19036	2.2	4.13	93.67	85.5	80.12
19063	1.06	6.8	92.14	87.	80.17
19089	.3	.17	99.53	96.	95.55
19105	2.33	3.67	94.	83.5	78.5
19106	1.33	2.47	96.2	90.5	87.07
19107	2.9	2.16	94.94	83.5	79.28
19108	.13	.87	99.	88.5	87.64
19125	.23	4.33	95.44	89.	84.94
19185	1.4	.6	98.	87.	85.26
19258	.17	2.47	97.36	87.	84.7
19260	1.73	.67	97.6	89.	86.88
19291	1.6	1.07	97.33	90.	87.6
19292	1.17	4.27	94.56	89.	84.16
19323	2.03	7.2	90.77	83.5	75.77
19324	2.1	1.73	96.17	90.5	87.03
19325	3.23	3.2	93.57	90.	84.21
19339	.37	5.57	94.06	88.5	83.24
19351	4.03	3.17	92.8	96.5	89.55

JAPANESE MILLET (*Chaetochloa italica*)

19255	.73	2.93	96.34	95.5	92.01

MILLET (*Chaetochloa italica*)

18792	.17	2.5	97.33	95.5	92.96
18860	3.27	1.73	95.	90.5	85.99
18907	1.17	4.83	94.	92.	86.48
19237	1.17	5.63	93.2	92.	85.75
19259	2.07	.63	97.3	91.5	89.04

SIBERIAN MILLET (*Chaetochloa italica*)

18662	.36	11.04	88.6	74.5	66.02
18736	5.78	4.5	89.72	84.25	75.6
18737	1.93	4.23	93.84	91.	85.4
18742	3.8	5.6	89.6	89.	79.76
18861	.9	3.73	95.37	91.	86.79
18865	1.2	3.3	95.5	88.5	84.51
19031	1.37	4.	94.63	88.5	83.78
19059	.96	10.5	88.54	90.5	80.14
19060	.5	4.9	94.6	89.	84.21
19123	.86	4.26	94.88	91.5	86.81
19124	.6	4.53	94.87	93.5	88.72
19102	.73	4.07	95.2	90.	85.68
19103	1.6	3.76	94.64	50.5	47.79
19207	3.36	2.2	94.44	87.5	82.63

SIBERIAN MILLET (*Chaetochloa italica*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
19238	.47	6.1	93.43	90.5	84.57
19239	.45	5.9	93.65	90.5	84.77
19293	.87	3.9	95.23	94.	89.52
19321	8.27	4.03	87.7	92.	80.68

ORCHARD GRASS (*Dactylis glomerata*)

18266	19.9	16.5	63.6	42.	26.71
18967	16.72	26.17	57.11	52.	29.71
19055	32.15	18.45	49.4	53.	26.19
19090	68.9	4.25	26.85	0.	0.
19091	19.05	2.6	78.35	74.	57.99
19092	44.9	3.2	51.9	75.5	39.19
19127	31.2	20.2	48.6	37.5	18.22
19208	48.9	2.35	48.75	77.5	37.77
19233	21.9	13.3	64.8	78.	50.56
19334	27.75	18.6	53.65	48.5	26.22
19335	35.3	6.6	58.1	78.	45.32

MEADOW FESCUE (*Festuca pratensis*)

19054	6.4	1.85	91.75	45.5	41.75

ALFALFA (*Medicago sativa*)

18780	3.	2.54	94.46	57.75	54.55
18943	12.7	.23	87.07	87.5	76.18
18980	7.02	.35	92.63	77.	71.32
18981	4.1	13.7	82.2	86.	70.71
19026	8.72	1.3	89.98	85.5	76.94
19027	10.47	.27	89.26	75.	66.96
19057	5.22	.07	94.71	81.5	77.21
19126	6.37	1.12	92.51	81.	74.93
19187	10.3	.17	89.53	72.	64.47
19209	1.22	...	98.78	83.	82.

JAPANESE BARNYARD MILLET (*Panicum crus-galli*).

18936	1.	3.65	95.35	90.5	86.3

TIMOTHY (*Phleum pratense*)

18651	.95	.95	98.1	40.75	39.95
18652	1.4	.8	97.8	89.	87.05
18653	.1	.75	99.15	90.25	89.49
18654	.65	.1	99.25	94.	93.31
18655	.35	...	99.65	89.5	89.2
18656	.9	.85	98.25	85.	83.53
18657	1.05	1.3	97.65	87.5	85.44
18674	....	...	100.	97.25	97.25
18675	.1	...	99.9	95.	94.91
18676	.9	.7	98.4	94.	92.52
18677	2.1	1.65	96.25	95.75	92.17
18678	1.1	.55	98.35	89.25	87.81
18679	.05	.2	99.75	96.75	96.52
18680	2.05	.55	97.4	95.25	92.78
18681	1.2	.05	98.75	94.25	93.09
18682	2.7	.75	96.55	93.	89.8
18683	1.	.56	99.25	93.	92.32
18684	3.3	1.1	95.6	92.	87.94
18685	.5	...	99.5	96.75	96.28
18686	.65	.1	99.25	92.	91.32
18687	2.3	.85	96.85	92.25	89.34
18688	4.7	2.65	92.65	94.	87.1
18689	1.8	1.	97.2	94.75	92.11
18690	.65	.05	99.3	92.25	91.62

TIMOTHY (*Phleum pratense*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
18691	3.05	1.85	95.1	93.	88.46
18692	1.2	.9	97.9	92.25	90.31
18693	1.15	2.1	96.75	94.5	91.45
18711	....	...	100.	85.25	85.25
18712	3.4	3.55	93.05	87.75	81.65
18713	1.	1.75	97.25	93.5	90.94
18714	2.25	5.	92.75	90.75	84.17
18715	2.35	.25	97.40	94.	91.57
18716	1.5	.8	97.7	94.75	92.59
18717	.25	.5	99.25	95.	94.29
18718	3.25	.85	95.9	58.25	55.86
18719	2.15	.8	97.05	90.5	87.84
18720	..	...	100.	95.25	95.25
18721	.6	.4	99.	87.5	86.63
18722	.05	.05	99.9	95.25	95.18
18723	.75	2.5	96.75	89.5	86.6
18724	2.55	1.85	95.6	88.25	84.36
18725	1.85	.1	98.05	92.25	90.46
18726	4.05	1.4	94.55	88.	83.21
18754	.3	4.45	99.25	82.25	81.64
18755	.2	.1	99.7	89.5	89.24
18756	1.9	1.7	96.4	89.5	86.28
18757	1.	1.7	97.3	83.5	81.24
18758	.2	.05	99.75	93.	92.78
18759	.1	...	99.9	90.	89.92
18760	.15	...	99.85	93.5	93.36
18761	.25	...	99.75	93.25	93.02
18762	1.1	1.2	97.7	90.5	88.44
18763	.05	...	99.95	96.25	96.2
18764	.3	...	99.7	93.5	93.22
18765	2.95	5.55	91.5	92.75	84.86
18766	.2	...	99.8	96.	95.8
18767	2.2	.85	96.95	91.	88.22
18768	.25	...	99.75	95.25	95.
18805	.8	.75	98.45	84.25	82.94
18806	.65	2.1	97.25	81.5	79.28
18807	1.7	3.7	94.6	86.5	81.84
18808	.25	1.5	98.25	92.5	90.88
18809	(a)	(a)	98.5	94.5	93.1
18810	.65	3.25	96.1	94.75	91.06
18811	(a)	(a)	99.5	92.	91.54
18812	(a)	(a)	99.5	91.	90.54
18813	2.1	1.6	96.3	92.5	89.08
18814	.3	.2	99.5	96.25	95.78
18815	1.7	.8	97.5	91.	88.72
18816	2.8	1.6	95.6	92.5	88.42
18817	(a)	(a)	98.5	92.5	91.12
18818	.4	.8	98.8	91.5	90.4
18819	.8	.7	98.5	85.	83.74
18820	(a)	(a)	98.5	95.5	94.07
18821	.9	.7	98.4	91.	89.54
18822	(a)	(a)	98.5	92.	90.62
18836	2.1	1.3	96.6	93.	89.84
18866	(a)	(a)	98.5	87.5	86.19
18667	(a)	(a)	98.5	92.	90.62
18868	(a)	(a)	98.5	91.5	90.13

(a) Amounts small and not reported.

TIMOTHY (*Phleum pratense*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
18869	.5	.25	99.25	81.5	80.9
18870	(a)	(a)	99.5	98.5	98.01
18889	1.3	.7	98.	84.5	82.83
18890	.55	.75	98.7	85,	83.92
18891	(a)	(a)	99.5	92.5	92.06
18892	(a)	(a)	99.5	86.5	86.07
18893	(a)	(a)	99.5	90.	89.56
18894	(a)	(a)	99.5	93.5	93.05
18895	(a)	(a)	99.5	88.	87.57
18896	(a)	(a)	99.5	95.	94.53
18897	(a)	(a)	99.5	88.5	88.07
18898	(a)	(a)	98.5	94.	92.61
18899	2.6	1.6	95.8	88.5	84.79
18947	.9	1.05	98.05	90.	88.27
18948	1.5	1.9	96.6	89.	85.98
18949	(a)	(a)	98.5	91.	89.64
18950	3.5	2.7	93.8	83.5	78.33
18951	(a)	(a)	99.5	92.	91.55
18952	(a)	(a)	99.5	91.5	91.05
18953	(a)	(a)	99.5	93.	92.55
18954	(a)	(a)	99.5	92.	91.55
18955	.5	.45	99.05	92.5	92.06
18956	1.5	2.4	96.1	84.5	81.2
18957	(a)	(a)	99.5	80.5	80.11
18982	2.4	2.3	95.3	85.	81.12
18983	(a)	(a)	99.5	87.5	87.07
18984	1.2	.7	98.1	57.5	56.43
18985	(a)	(a)	99.5	91.5	91.05
18986	2.	2.	96.	92.	88.33
18987	1.4	.7	97.9	86.	84.21
18988	(a)	(a)	99.5	92.	91.55
18989	2.3	3.2	94.5	84.	79.39
18990	1.9	1.2	96.9	63.5	61.53
19011	4.1	3.8	92.1	85.5	78.76
19012	.5	.4	99.1	88.5	87.72
19013	(a)	(a)	98.5	89.	87.69
19014	(a)	(a)	99.5	77.	76.63
19015	(a)	(a)	98.5	86.5	85.22
19020	(a)	(a)	98.5	84.	82.74
19021	.7	.95	98.35	89.5	88.04
19022	.75	.75	98.5	90.	88.66
19023	(a)	(a)	99.5	85.	84.59
19024	.6	2.9	96.5	85.75	82.75
19025	1.2	1.3	97.5	88.	85.8
19050	(a)	(a)	99.5	84.	83.59
19051	1.2	1.7	97.1	95.5	92.73
19052	.6	.2	99.2	92.	91.28
19053	.4	...	99.6	89.5	89.16
19070	(a)	(a)	99.5	92.5	92.05
19071	2.5	2.2	95.3	66.5	63.36
19072	2.	1.5	96.5	92.5	89.26
19073	2.5	1.6	95.9	81.5	78.14
19074	1.4	1.5	97.1	85.5	83.04
19075	(a)	(a)	98.5	80.	78.9

TIMOTHY (*Phleum pratense*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
19076	...	.8	99.2	92.5	91.78
19077	.5	.95	98.55	88.5	87.23
19086	(a)	(a)	99.5	94.	93.54
19087	(a)	(a)	98.5	86.5	85.21
19088	1.7	.5	97.8	87.	85.19
19109	1.8	1.5	96.7	87.	84.14
19110	1.6	1.7	96.7	75.	72.54
19111	(a)	(a)	98.5	88.	86.69
19136	(a)	(a)	98.5	89.	87.68
19137	1.	.4	98.6	88.5	87.27
19138	.55	.65	98.8	89.	87.95
19139	(a)	(a)	99.5	82.5	82.09
19140	(a)	(a)	99.5	82.	81.59
19141	1.8	1.9	96.3	83.	79.94
19142	(a)	(a)	99.5	90.	89.56
19143	(a)	(a)	99.5	95.	94.53
19144	.3	.5	99.2	81.5	80.86
19145	1.2	.7	98.1	81.	79.47
19146	.25	.2	99.55	71.5	71.18
19171	1.1	.5	98.4	98.5	96.95
19172	(a)	(a)	99.5	84.	83.59
19173	.7	.4	98.9	83.5	82.58
19174	.05	.2	99.75	95.	94.77
19175	(a)	(a)	99.5	90.5	90.05
19176	(a)	(a)	99.5	88.5	88.07
19177	1.	1.9	97.1	73.5	71.37
19178	1.2	.1	98.7	92.5	91.31
19198	(a)	(a)	99.5	92.5	92.05
19199	1.5	1.6	96.9	91.5	88.67
19200	.4	.2	99.4	95.5	94.94
19201	.2	.2	99.6	90.	89.64
19202	(a)	(a)	99.5	95.5	95.03
19203	(a)	(a)	98.5	86.5	85.21
19204	.4	.65	98.95	90.5	89.55
19205	(a)	(a)	99.5	90.5	90.05
19206	(a)	(a)	99.5	81.5	81.11
19222	(a)	(a)	98.5	97.	95.56
19223	1.3	....	98.7	92.5	91.32
19224	(a)	(a)	99.5	84.5	84.09
19225	1.5	2.6	95.9	88.	84.39
19226	.5	2.9	96.6	86.	83.09
19227	2.9	4.2	92.9	79.	73.4
19228	(a)	(a)	99.5	93.	92.53
19229	(a)	(a)	99.5	87.	86.58
19230	(a)	(a)	99.5	94.	93.55
19246	1.7	1.4	96.9	82.5	79.94
19247	(a)	(a)	98.5	87.5	86.19
19248	(a)	(a)	99.5	92.5	92.06
19249	.2	.8	99.	90.25	89.36
19273	.5	1.5	98.	91.	89.18
19274	(a)	(a)	98.5	83.5	82.25
19275	2.2	4.7	93.1	84.	78.2
19276	1.6	2.2	96.2	87.5	84.18
19277	(a)	(a)	98.5	73.5	72.41
19278	(a)	(a)	98.5	86.	84.71
19279	(a)	(a)	99.5	88.	87.57

TIMOTHY (*Phleum pratense*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
19280	(a)	(a)	98.5	82.	80.77
19281	(a)	(a)	99.5	89.	88.58
19288	(a)	(a)	99.5	92.	91.56
19289	(a)	(a)	98.5	84.	82.74
19290	.9	1.5	97.6	93.5	91.26
19306	(a)	(a)	99.5	82.5	82.1
19309	(a)	(a)	99.5	90.5	90.06
19310	1.7	1.1	97.2	98.5	95.74
19327	1.4	1.	97.6	88.	85.89
19328	(a)	(a)	99.5	91.	90.56
19329	.6	.45	98.95	91.	90.04
19330	(a)	(a)	98.5	80.5	79.29
19331	(a)	(a)	98.5	73.5	73.4
19332	(a)	(a)	99.5	89.5	89.08
19333	1.7	2.3	96.	53.5	51.36
19353	.6	.4	99.	88.5	87.62
19354	1.45	.8	97.75	35.	34.21
19355	(a)	(a)	98.5	89.	87.87
19356	1.4	.9	97.7	88.	85.98
19357	(a)	(a)	98.5	90.	88.65
19358	(a)	(a)	98.5	84.5	83.23
19359	1.1	1.2	97.7	95.5	93.3
19360	(a)	(a)	98.5	90.5	89.14
19361	(a)	(a)	99.5	97.	96.54
19362	2.2	2.5	95.3	89.5	85.29
19363	4.8	2.3	92.9	87.5	81.29
19364	(a)	(a)	99.5	87.5	87.08
19365	(a)	(a)	98.5	87.	85.7
19366	(a)	(a)	98.5	77.	75.85
19367	(a)	(a)	98.5	93.	91.61
19368	(a)	(a)	99.5	85.	84.59
19369	(a)	(a)	98.5	81.	79.79

KENTUCKY BLUEGRASS (*Poa pratensis*)

18660	14.5	.2	85.3	36.75	31.35
18842	25.1	59.26	15.64	24.75	3.87
18908	39.2	55.7	5.1	21.25	1.08
18944	22.5	.5	77.	89.25	68.72
19097	23.1	.1	76.8	79.75	61.25
19098	6.7	.3	93.	79.75	74.17
19152	17.	.3	82.7	48.75	40.32
19235	28.1	1.	70.9	58.	41.12

ALSIKE CLOVER (*Trifolium hybridum*)

18646	.35	14.95	84.7	80.25	67.97
18647	3.4	16.1	80.5	80.5	64.8
18648	2.15	19.1	78.75	78.	61.44
18649	1.6	10.55	87.85	79.5	69.84
18650	9.2	9.65	81.15	80.	64.92
18695	7.3	5.05	87.65	76.	66.62
18696	13.2	6.55	80.25	87.25	70.02
18697	6.15	1.7	92.15	92.25	85.
18698	6.15	1.25	92.6	87.75	81.25
18699	3.	3.	94.	79.	74.27
18700	2.3	9.	88.7	74.	65.64
18701	3.95	11.1	84.95	81.5	69.25
18727	5.35	2.7	91.95	76.	68.97

ALSIKE CLOVER (*Trifolium hybridum*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
18728	3.8	13.55	82.65	3.75	3.1
18729	3.25	12.65	84.1	73.	61.4
18730	2.55	2.1	95.35	91.25	87.02
18731	1.55	3.8	94.65	74.25	70.29
18732	3.6	3.95	92.45	81.	74.89
18733	3.1	12.7	84.2	71.75	60.42
18734	2.9	2.8	94.3	81.	76.4
18735	9.7	3.85	86.45	75.75	65.48
18769	2.6	10.2	87.2	49.	42.73
18770	2.2	3.75	94.05	79.25	74.54
18771	4.2	13.85	81.95	39.5	32.37
18772	2.3	11.35	86.35	75.75	65.4
18803	5.35	7.5	87.15	76.	66.24
18804	3.3	10.35	86.35	71.5	61.75
18823	13.95	27.7	58.35	49.	28.59
18824	4.15	4.	91.85	84.	77.16
18850	11.	3.2	85.8	81.5	69.94
18851	25.	11.9	63.1	91.5	57.74
18852	7.4	13.5	79.1	64.	50.63
18853	8.	11.3	80.7	81.5	65.77
18921	9.7	16.7	73.6	84.	61.82
18922	1.1	3.3	95.6	82.5	78.87
18923	.8	2.7	96.5	88.5	85.4
18924	8.1	1.4	90.5	93.	84.18
18925	8.2	17.5	74.3	46.	34.18
18926	8.4	8.5	83.1	82.5	68.56
18927	5.7	9.7	84.6	71.	60.8
18928	1.5	2.5	96.	82.	78.83
18945	12.4	16.9	70.7	87.	61.52
18946	2.5	1.9	95.6	84.	80.31
18962	4.6	10.3	85.1	86.5	73.62
18963	3.	3.85	93.15	77.25	71.96
18964	2.5	3.	94.5	92.	86.95
18965	14.4	1.1	84.5	83.5	70.56
18966	2.3	11.	86.7	71.	61.56
19004	8.7	6.3	85.	82.5	70.14
19005	10.7	5.1	84.2	80.	67.36
19006	13.	1.9	85.1	73.5	62.55
19007	8.6	1.9	89.5	83.	74.29
19008	2.1	3.4	94.5	93.5	83.38
19009	6.7	11.4	81.9	90.5	74.13
19010	13.3	9.2	77.5	84.5	65.49
19039	1.75	4.05	94.2	81.	76.32
19040	1.85	7.85	90.3	63.	56.89
19041	1.5	8.1	90.4	68.	61.48
19042	2.85	3.5	93.65	73.25	68.6
19058	5.35	5.85	88.8	54.5	48.41
19066	3.75	10.25	86.	50.	42.99
19067	.5	1.2	98.3	83.75	82.35
19068	1.3	7.35	91.35	69.75	63.74
19069	2.25	5.75	92.	77.75	71.53
19078	1.25	5.85	92.9	77.	71.54
19112	3.	4.5	92.5	80.75	74.7
19113	2.	9.85	88.15	68.25	60.17
19114	1.	7.7	91.3	64.5	58.89
19115	.35	.5	99.15	83.	82.3

ALSIKE CLOVER (*Trifolium hybridum*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
19128	6.	3.2	90.8	89.5	81.28
19129	6.5	11.7	81.8	73.5	60.13
19130	6.3	10.6	83.1	78.5	65.24
19154	9.8	12.2	78.	85.	66.3
19155	4.2	2.7	93.1	82.5	76.8
19156	11.1	23.2	65.7	90.5	59.46
19157	5.4	3.8	90.8	81.5	74.
19179	14.1	20.8	65.1	75.5	49.15
19180	7.1	12.5	80.4	86.5	69.56
19181	3.3	4.8	91.9	84.	77.2
19182	2.3	3.5	94.2	79.	74.42
19183	4.9	12.7	82.4	80.5	66.34
19184	18.8	24.7	56.5	83.5	47.18
19210	6.3	13.	80.7	87.	70.22
19250	3.5	14.7	81.8	91.	74.46
19251	2.8	12.3	84.9	79.5	67.5
19252	2.9	8.2	88.9	76.	67.57
19253	13.8	20.5	65.7	30.5	20.04
19254	5.6	6.1	88.3	83.5	73.74
19269	2.	11.5	86.5	88.5	76.55
19270	8.3	11.2	80.5	80.	64.4
19271	1.1	2.7	96.2	73.	70.23
19272	8.75	7.55	83.7	93.5	78.26
19295	9.9	12.7	77.4	79.	61.15
19296	9.8	23.8	66.4	34.	22.58
19297	13.2	9.	77.8	84.	65.35
19298	6.5	13.	80.5	70.5	56.75
19299	13.9	11.	75.1	82.	61.58
19318	8.5	12.5	79.	74.	58.46
19319	5.7	2.1	92.2	80.	73.76
19320	7.2	14.7	78.1	76.5	59.75
19342	18.2	18.3	63.5	55.5	35.24
19343	9.2	7.4	83.4	82.5	68.81
19344	7.6	2.3	90.1	80.	72.08
19345	.6	2.9	96.5	70.5	68.03
19346	1.6	3.1	95.3	87.25	83.19

CRIMSON CLOVER (*Trifolium incarnatum*)

18841	4.25	.18	95.57	4.5	4.3
18846	2.75	.63	96.62	24.	23.19
18929	3.45	.68	95.87	15.	14.38
19341	4.53	.42	95.05	2.5	2.38

MAMMOTH CLOVER (*Trifolium pratense var*)

18702	4.02	2.74	93.24	32.	29.84
18743	7.5	7.32	85.18	84.5	71.98
18744	2.92	.9	96.18	92.75	89.21
18785	3.	5.74	91.26	91.	83.04
18786	1.64	1.64	96.72	93.	89.94
18848	3.25	5.3	91.45	91.	83.22
18849	2.88	3.3	93.82	91.75	86.07
18940	2.5	1.93	95.57	89.25	85.31
18941	1.3	2.6	96.1	87.	83.61
18958	2.12	3.43	94.45	90.	85.02
18993	1.13	.17	98.7	93.	91.81
19000	4.17	45.93	49.9	92.25	46.07
19028	2.9	3.42	93.68	89.25	83.62

MAMMOTH CLOVER (*Trifolium pratense var*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
19029	2.18	4.57	93.25	87.	81.14
19081	2.83	2.92	94.25	87.	82.
19131	4.57	6.64	88.79	86.75	77.03
19132	9.7	13.52	76.78	84.25	64.69
19134	3.	.75	96.25	93.	89.51
19153	6.47	7.3	86.23	66.75	57.56
19190	2.75	1.62	95.63	50.5	48.29
19218	3.3	6.02	90.68	94.5	85.7
19219	7.25	2.38	89.87	80.	71.9
19220	5.47	7.12	87.41	86.75	75.83
19236	3.1	3.17	93.73	87.5	82.
19261	2.75	6.12	91.13	89.5	81.57
19262	5.45	6.85	87.7	90.5	79.37
19294	2.8	2.75	94.45	85.	80.28
19317	4.95	3.37	91.68	86.5	79.3
19347	2.11	9.1	88.79	90.5	80.36
19348	6.75	5.38	87.87	72.	63.27

RED CLOVER (*Trifolium pratense*)

18641	7.32	5.12	87.56	84.75	74.21
18642	1.6	2.6	95.8	90.75	86.94
18643	10.42	5.78	83.8	92.5	77.5
18644	3.76	5.28	90.96	87.5	79.59
18645	1.9	7.1	91.	90.75	82.58
18665	4.1	3.9	92.	85.	78.2
18666	6.1	6.3	87.6	90.25	79.06
18667	11.22	5.38	83.4	90.	75.06
18668	5.22	3.22	91.56	80.5	73.7
18669	1.36	1.24	97.4	92.5	90.1
18670	.9	.1	99.	97.25	96.3
18671	3.68	5.68	90.64	92.75	84.08
18672	2.9	2.8	94.3	95.75	90.29
18673	2.54	3.26	94.2	93.25	87.87
18745	6.8	1.34	91.86	94.	86.36
18746	7.06	2.24	90.7	91.	82.54
18747	12.5	2.64	84.86	92.25	78.12
18748	8.2	4.5	87.3	.75	.65
18749	9.08	2.5	88.42	91.75	81.12
18750	6.28	2.04	91.68	93.5	85.72
18751	3.22	4.46	92.32	96.25	88.86
18752	.6	.2	99.2	94.75	94.
18753	13.44	5.44	81.12	72.75	59.01
18773	4.34	2.62	93.04	87.	80.96
18774	1.44	1.64	96.92	91.25	88.44
18775	1.6	.1	98.3	95.25	93.62
18776	1.1	.08	98.82	88.	86.98
18777	1.8	1.84	96.36	91.	87.7
18778	2.7	11.3	86.	80.	68.8
18779	6.38	5.72	87.9	91.5	80.42
18798	5.7	4.6	89.7	85.5	76.72
18799	3.1	5.5	91.4	85.	77.68
18800	3.9	5.85	90.25	91.25	82.34
18801	4.5	3.4	92.1	79.25	73.
18802	9.05	11.62	79.33	86.	68.22
18829	6.42	2.32	91.26	84.	76.65
18830	7.6	12.5	79.9	92.	73.5

RED CLOVER (*Trifolium pratense*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
18831	1.23	.57	98.2	95.	93.3
18832	3.82	4.14	92.04	88.25	81.22
18833	2.9	4.4	92.7	90.5	83.9
18834	2.04	3.7	94.26	92.	86.72
18835	1.14	1.34	97.52	91.	88.76
18854	10.37	13.5	76.13	88.5	67.37
18855	1.87	1.13	97.	90.5	87.8
18856	10.6	7.93	81.47	84.	68.43
18857	4.05	1.	94.95	98.	93.07
18858	8.26	3.63	88.11	90.5	79.75
18859	6.1	15.82	78.08	88.	68.71
18900	2.82	2.58	94.6	88.	83.25
18909	2.48	2.5	95.02	84.75	80.54
18910	1.1	1.	97.9	68.	66.59
18911	2.08	1.72	96.2	87.25	83.94
18912	12.86	15.23	71.91	76.	54.66
18913	3.87	5.8	90.33	71.5	64.59
18914	.37	.28	99.35	91.5	90.91
18915	1.55	2.45	96.	93.	89.29
18916	2.65	6.27	91.08	86.	78.33
18917	2.6	3.37	94.03	86.5	81.35
18918	3.73	3.23	93.04	82.	76.31
18919	2.2	3.67	94.13	85.5	80.07
18920	1.12	.07	98.81	93.5	92.4
18937	6.63	8.47	84.9	87.	73.88
18938	.62	.05	99.33	91.	90.39
18939	5.4	8.13	86.47	79.5	68.75
18942	1.47	1.53	97.	85.	82.46
18959	1.38	1.57	97.05	89.	86.38
18960	5.08	7.97	86.95	41.5	36.08
18961	2.7	4.18	93.12	88.	81.94
19001	7.83	9.57	82.6	77.5	64.02
19002	12.57	3.22	84.21	95.5	80.43
19003	1.05	.05	98.9	92.	91.
19016	1.4	.85	97.75	89.	87.02
19017	4.4	3.27	92.33	92.	84.95
19018	5.25	48.93	45.82	95.	43.53
19019	2.92	1.13	95.95	87.5	83.96
19030	2.48	5.35	92.17	83.5	76.98
19032	4.97	11.23	83.8	77.	64.52
19033	1.88	4.8	93.32	85.	79.34
19034	3.18	5.5	91.32	84.5	77.18
19056	1.5	.38	98.12	93.5	91.76
19079	3.8	4.5	91.7	85.	77.94
19080	1.92	1.88	96.02	87.5	84.18
19082	2.2	1.73	96.07	89.5	85.98
19083	2.37	3.01	94.62	89.5	84.7
19084	6.6	8.56	84.84	94.5	80.19
19085	4.05	1.55	94.4	76.	71.74
19093	5.25	10.25	84.5	93.	78.58
19099	8.67	5.48	85.85	91.5	78.55
19100	1.42	3.63	94.95	90.	85.46
19101	1.75	3.3	94.95	84.	79.77
19133	3.67	5.13	91.2	86.5	78.89
19135	8.38	8.87	82.75	78.	64.55
19151	2.92	.43	96.65	86.5	83.61

RED CLOVER (*Trifolium pratense*)

Test No.	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent	Germination of pure seed, Percent	Actual value, Percent
19158	2.	6.5	91.5	91.	83.26
19159	3.92	4.87	91.21	90.5	82.54
19160	1.55	1.12	97.33	89.5	87.13
19161	6.22	3.02	90.76	93.	84.42
19162	7.3	7.32	85.38	88.5	75.57
19163	.32	.72	98.96	97.5	96.51
19164	4.3	.92	94.78	85.5	81.15
19165	2.4	.5	97.1	93.	90.31
19191	2.32	.37	97.31	90.	87.6
19192	15.85	9.75	74.40	67.	49.85
19193	3.73	2.65	93.62	92.	86.14
19194	1.92	.27	97.81	93.5	91.47
19195	3.97	3.4	92.63	92.5	85.68
19196	3.2	4.5	92.3	92.	84.92
19197	3.4	4.42	92.18	94.	86.65
19215	3.35	.07	96.58	89.	85.96
19216	6.3	1.2	92.5	90.	83.26
19217	17.35	10.62	72.03	82.	59.07
19221	12.85	6.72	80.43	90.	72.42
19231	10.02	8.87	81.11	87.5	70.97
19240	7.12	2.8	90.08	91.	81.92
19241	4.57	5.8	89.63	90.	80.67
19242	12.57	5.65	81.78	84.5	69.11
19243	2.	.5	97.5	94.5	92.16
19244	4.37	5.06	90.57	88.	79.71
19245	.93	.1	98.97	91.	90.06
19263	3.92	11.98	84.1	64.	53.82
19264	4.67	8.58	86.75	77.5	67.24
19265	3.37	5.43	91.2	88.5	80.72
19300	1.77	.98	97.25	92.5	89.96
19301	2.43	3.92	93.65	82.5	77.26
19302	1.82	1.23	96.95	94.5	91.62
19303	4.55	8.88	86.57	90.5	78.35
19304	6.95	10.37	82.68	84.5	69.86
19305	1.8	2.75	95.45	89.	84.95
19308	5.12	4.01	90.87	78.5	71.33
19315	1.88	2.7	95.42	88.5	84.45
19316	6.37	3.48	90.15	83.5	75.28
19349	4.7	8.88	86.42	83.	71.73
19350	4.47	3.13	92.4	85.5	79.
19352	2.62	2.43	94.95	86.	81.66

WHITE CLOVER (*Trifolium repens*)

18694	4.3	8.45	87.25	61.5	53.66
18843	4.	5.2	90.8	75.5	68.55
18844	2.2	4.8	93.	79.	73.49
18845	8.5	12.8	78.7	21.5	16.79
18968	7.	15.9	77.1	36.5	28.11
19038	12.3	14.	73.7	18.	13.27
19064	4.5	6.2	89.3	78.5	70.12
19065	5.3	5.	89.7	84.	75.38
19094	5.3	9.4	85.3	83.5	71.22
19095	2.4	15.4	82.2	79.	64.94
19234	3.7	8.1	88.2	69.	60.86
19267	3.2	6.2	90.6	72.5	65.69
19268	2.3	3.7	94.	17.5	16.45
19287	3.	7.9	89.1	52.	46.33

LAWN GRASS MIXTURE

Test No.	Kind of seed	Percent	Inert matter, Percent	Foreign seed, Percent	Pure seed, Percent
18934	*Agrostis,*	20.45	14.57	.51	84.92
	Phleum pratense,	19.13			
	Poa pratensis,	17.6			
	Lolium perenne,	16.5			
	Festuca,	7.49			
	Other seeds,	3.75			
18974	*Phleum pratense,*	40.5	12.6	.2	87.2
	Trifolium repens,	21.			
	Agrostis,	23.			
	Other seeds,	2.7			
18991	*Phleum pratense,*	50.73	8.9	1.17	89.93
	Trifolium repens,	20.04			
	Agrostis alba,	19.16			
18992	*Phleum pratense,*	35.2	23.5	1.6	74.9
	Agrostis,	13.1			
	Trifolium repens,	9.5			
	Dactylis glomerata,	7.			
	Poa compressa,	6.6			
	Other seeds,	3.5			
19037	*Agrostis,*	36.4	3.5	1.3	95.2
	Phleum pratense,	36.5			
	Trifolium hybridum,	12.5			
	Trifolium repens,	9.1			
	Other seeds,	.7			
19096	*Agrostis,*	33.4	15.2	.6	84.2
	Poa pratensis,	29.			
	Trifolium repens,	19.9			
	Other seeds,	1.9			
19282	*Poa compressa,*	17.1	27.1	1.	71.9
	Poa pratensis,	15.6			
	Lolium,	11.8			
	Agrostis,	11.9			
	Other seeds,	15.5			
19283	*Phleum pratense,*	70.29	8.77	1.4	89.83
	Agrostis,	10.87			
	Other seeds,	8.67			
19326	*Phleum pratense,*	76.1	8.2	.2	91.6
	Agrostis,	11.5			
	Other seeds,	4.			

CONDENSED DATA PERTAINING TO ARTICLE ON FEEDING TRIALS WITH COWS

I. Weights of cows.

II. Average barn temperatures, with ranges and percentages of uniformity.

III. Analyses and digestible ingredients in fodders and feeds; (*a*) analyses on dry basis; (*b*) digestion co-efficients; (*c*) pounds of digestible nutrients in 100 pounds of original substance.

IV. Feeding records of the individual cows in feeding tests.

V. Production records; showing production and same per unit for each individual cow in feeding tests.

VI. Difference tables: (*a*) total differences; (*b*) percentage differences.

VII. Results of experimental feeding on different rations.

I. WEIGHTS OF COWS

Period	Stella	Eunice	Constance	Beautina	Lady Perusia	Serena	Minta Bella	Judith	Lucerne	Yuba
I beginning	...	...	743	908	...	...	802	840	...	...
I end	857	875	740	895	...	...	805	858	765	937
II	831	861	733	930	...	...	805	863	803	945
III	860	860	780	925	1022	800	838	915	782	955
IV	795	847	800	952	992	805	...	...	782	980
V	788	857	836	...	905	785	...	...	765	945

Period	Lavender	Ursula	Elsa	Vivian	Acme	Atalanta	Elizabeth	Santa Clara	Mona	Orpha
I beginning	952	998	...	...	1022	945	812	836	...	1055
I end	950	992	970	865	1008	950	800	847	...	1050
II	930	975	975	863	968	915	797	860	975	1080
III	965	994	983	858	918	940	786	880	981	1131
IV.	940	940	993	857	848	893	780	892	992	1120
V	918	938	1010	831	910	932	835	868	991	...

Period	Alta	Adelaide	Nancy B.	Una	Surprise	Sonoma	Ceres	Maid Marian	Rosemary	Max Belle
I beginning	833	955	1073	755	732	...	...	...	...	965
I end	833	958	1072	770	767	...	...	980	...	952
II	857	948	1068	760	778	863	909	930	840	965
III	903	998	1080	818	808	861	902	928	853	992
IV	900	995	1075	812	800	832	895	875	795	997
V	927	1002	1111	867	838	861	866	897	811	1005

Period	Muriel	Eva	Mermaid	Edith	Eleanor	Queenie	Linnet	Flora	Rosel	Juanita
I beginning	690	845	843	887	873	765	633	956	1046	822
I end	695	845	850	915	913	805	643	965	1040	800
II	690	868	865	937	913	820	655	920	1026	813
III	726	891	880	957	933	863	650	940	1031	823
IV	722	890	865	...	932	...	680	917	1020	840
V	778	840	866	...	945	...	691	896	1053	832

Period	Pomona	Mayfair	Hallowe'en	Inez	Fresno	Jersey Lily	Star Bright	Stephanie	Lizzie Hexham	Santa Rosa
I beginning	...	...	...	...	916	852	1097	846	897	880
I end	867	...	848	880	895	865	1092	837	900	875
II	810	641	880	867	895	843	1117	830	933	873
III	783	653	880	876	873	885	1133	841	965	896
IV	797	675	802	860	887	892	1132	835	...	902
V	750	665	855	845	915	950	1153	835	...	938

Period	Yemassee	Janice	Haidee
I beginning	930	910	1015
I end	923	898	1033
II	910	908	1065
III	940	968	1141
IV	938	945	...
V	...	990	...

II. AVERAGE BARN TEMPERATURES, WITH RANGES AND PERCENTAGES OF UNIFORMITY

Period number		Average temperature			Range of temperature			Percent of whole within 3° F. of mean		
		5 A.M.	12 M.	6 P.M.	5 A.M.	12 M.	6 P.M.	5 A.M	12 M.	6 P.M.
					MAIN BARN					
I	Pre.	53	49	49	45-57	40-56	42-59	34	67	58
	Exp.	48	46	47	36-60	36-59	39-55	56	65	78
II.	Pre.	49	48	48	37-59	38-56	42-53	50	50	67
	Exp.	49	47	47	32-59	37-50	42-56	74	65	48
III.	Pre.	49	46	49	38-53	40-50	48-53	67	67	83
	Exp.	51	47	52	43-62	44-56	49-57	61	78	91
IV.	Pre.	53	51	53	45-62	45-59	49-59	58	67	75
	Exp.	50	53	56	41-62	48-60	52-60	44	74	69
V.	Pre.	58	65	60	45-62	56-69	56-63	75	58	83
	Exp.	63	69	69	58-70	60-76	59-78	70	70	43
					ANNEX BARN					
I.	Pre.	54	53	53	44-59	48-56	48-56	58	83	83
	Exp.	48	46	48	38-60	39-56	37-50	39	56	52
II.	Pre.	50	47	50	39-60	41-55	36-56	33	50	33
	Exp.	48	49	51	32-63	42-59	40-59	39	56	56
III.	Pre.	48	49	50	40-57	39-59	45-59	67	33	50
	Exp.	50	49	52	40-67	43-57	46-59	87	39	44
IV.	Pre.	55	55	55	47-63	48-62	50-60	33	42	67
	Exp.	54	57	57	48-64	50-63	48-63	52	61	65
V.	Pre.	61	66	67	47-68	60-68	60-69	58	50	67
	Exp.	64	71	72	53-74	61-79	65-79	70	22	39

III. ANALYSES AND DIGESTIBLE INGREDIENTS IN FODDERS AND FEEDS

(a) ANALYSES ON DRY BASIS; (b) DIGESTION COEFFICIENTS; (c) POUNDS OF DIGESTIBLE NUTRIENTS IN 100 POUNDS OF ORIGINAL SUBSTANCE

(a) ANALYSES ON DRY BASIS

Fodders and feeds	Dates of sampling	Original substance		Composition of dry matter							
		Water	Dry matter	Crude ash	Crude protein	Crude fiber	Nitrogen-free extract	Ether extract	Nitrogen	Phosphoric acid	Potash
Hay, main barn	Dec.-Feb. March-May	14.42 13.61	85.58 86.39	6.48 6.69	9.44 9.94	33.58 21.56	48.84 48.66	2.66 3.15	1.51 1.59	0.55 0.61	1.90 1.91
Hay, annex barn	Dec.-Feb. March-May	14.62 12.51	85.38 87.49	6.36 5.29	9.50 8.00	30.15 33.44	51.22 50.63	2.77 2.64	1.52 1.28	0.54 0.44	1.69 1.64
Oat hay	Dec.-Feb. March	14.73 13.64	85.27 86.36	8.75 8.98	10.81 12.06	33.33 32.70	45 03 44.07	2.08 2.19	1.73 1.93	0.82 0 83	3.18 3.57
Silage	Dec.-Jan. Jan.-Feb Mar.-Apr. Apr.-May	77.54 79.26 77.61 79.41	22.46 20.74 22.39 20.59	6.34 6.07 6.23 6.60	8.75 8.56 8.62 8.50	24.61 26.53 25 55 27.58	57.98 56.67 57.39 55.14	2.32 2.17 2.21 2,16	1.40 1.37 1.38 1.36	0.77 0.78 0.63 0.78	1.90 1.91 1.67 1.98
Mixed feed No. 1	Dec.-Feb. March-May	12.15 11.56	87.85 88.44	7.30 6.88	28.75 27.69	8.75 9.70	49.05 49.22	6.15 6 51	4.60 4.43	2.64 2.59	1.78 1.79
Mixed feed No. 2	Dec.-Feb. March-May	14.90 14.09	85.10 85.91	5.40 5.63	16.50 16.56	6.75 6.91	68.36 67.61	2.92 3.39	2.64 2.65	2.16 2.40	1.35 1.47
Mixed feed No. 3	Dec.-Feb. March-May	13.70 11.26	86.30 88.74	5.57 5.76	25.69 24.50	5.75 5.90	58.07 58.22	4.92 5.62	4.11 3,92	1.97 2.09	1.41 1.63
Mixed feed No. 4	Dec.-Feb. March-May	12.25 12.02	87.75 87.98	5.31 5.94	16.75 16.00	7.16 6.63	64.90 64.92	5.88 6.51	2.68 2.56	2.46 2.59	1.42 1.52
Mixed feed No. 5	Dec.-Feb. March-May	11.65 10.64	88.35 89.36	5.74 5.96	25.00 24.81	7.03 6.65	54.25 54.84	7.98 7.74	4.00 3.97	2.32 2.32	1.40 1.46
Mixed feed No. 6	Dec.-Feb. March-May	11.10 11.27	88.90 88.73	4.85 3.99	25.43 29.19	7.11 5.80	57.74 56.70	4.87 4.32	4.07 4.67	1.92 1.81	1.15 1.16
Mixed feed No. 7	Dec.-Feb. March-May	10.05 10.33	89.95 89.67	6.95 6.46	25.69 21.81	9.87 10.22	52.06 56.50	5.43 5.01	4.11 3.49	1.82 1.90	1.87 1.77
Wheat bran	Dec.-Feb. March-May	12.65 14,32	87.35 85.68	6.57 6.91	19.37 18.13	9.18 10.55	60.28 60.79	4.60 3.62	3.10 2.90	3.09 3.47	1.75 2.08
Cottonseed meal	Dec.-Feb. March-May	9.53 5.93	90.47 94.07	8.23 7.37	49.37 48.25	5.41 4.95	27.24 29.21	9.75 10·22	7.90 7.32	3.17 3.01	2.25 2.11
Linseed meal	Dec.-Feb. March-May	11.40 10.15	88.60 89.85	6.11 6.37	34.94 34.18	8.71 8.75	42.06 43.80	8.18 6.90	5.59 5.47	1.53 1.87	1.42 1.36
Chicago gluten meal	Dec.-Feb. March-May	10.05 9.10	89.95 90.90	1.44 1.50	40.75 40.50	1.49 0.97	51.72 52.16	4.60 4.87	6.52 6.48	0.61 0.59	0.15 0.14
Hominy feed	Dec.-Feb. March-May	12.65 12.00	87,35 88.00	3.21 3.34	12.12 11.94	3.76 3.33	72.75 72.33	8.16 9.06	1.94 1.91	1.41 1.52	0.88 0.98
Molasses beet pulp	Dec.-Feb. March-May	6.75 7.35	93.25 92.65	6.87 6.56	10.69 10.37	15.73 16.42	66.27 66.01	0.44 0.64	1.71 1.66	0.29 0.28	1.78 1.76
India wheat	Dec.-Feb. March-May	18.90 15.72	81.10 84.28	4.08 3,21	16.37 12.13	3.21 2.82	74.48 80.14	1.86 1.70	2.62 1.94	1.48 1.02	1.01 0.70

(*b*) DIGESTION COEFFICIENTS *

Fodders and feeds	Dry matter	Crude protein	Crude fiber	Nitrogen-free extract	Ether extract
Hay †	60	57	58	64	57
Oat hay	49	54	44	52	62
Immature corn silage	66	51	71	67	80
Molasses beet pulp	82	63	83	84	..
Mixed feed No. 1 ‡	67	83	39	71	78
“ “ No. 2 ‡	65	78	26	69	70
“ “ No. 3 ‡	70	84	36	69	84
“ “ No. 4 ‡	71	78	37	79	75
“ “ No. 5 ‡	76	84	48	81	83
“ “ No. 6 ‡	71	84	28	76	72
“ “ No. 7 ‡	74	81	62	76	81
Wheat bran	62	78	29	69	68
Cottonseed meal	74	88	56	61	93
Linseed meal (O. P.)	79	89	57	78	89
India wheat §	70	77	..	68	79
Hominy chop	90	77	82	95	81
Chicago gluten meal	90	88	..	90	94

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* From tables of digestibility of American feeding stuffs; Jordan and Hall, Bul. 77, Office Exp. Sta. U. S. Dept. Agr. (1900).

† Assumed to be two-thirds timothy in bloom and one-third red clover; perhaps a somewhat high assumption as regards clover.

‡ Calculated from analyses of their ingredients and from digestion coefficients of the same.

§ Assumed same as buckwheat, the digestion coefficients for which were calculated from the statement in Henry (Feeds and Feeding), who appears to have drawn the data from Dietrich and Koenig's Zusammensetzung der Futtermittel.

(c) POUNDS OF DIGESTIBLE NUTRIENTS IN 100 POUNDS OF ORIGINAL SUBSTANCE

Fodders and feeds	Digestible nutrients					Nutritive ratio, 1 :
	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	
Hay, main barn	51.4	4.6	16.2	26.8	1.3	10.0
	51.8	4.9	15.8	26.9	1.6	9.5
Hay, annex barn	51.2	4.6	14.9	28.0	1.4	....
	52.5	4.0	17.0	28.4	1.3	....
Oat hay	41.8	5.0	12.5	20.0	1.1	....
	42.3	5.6	12.4	19.8	1.2	....
Silage, immature corn	14.3	0.96	3.9	8.3	0.04	....
	14.2	0.94	4.0	8.1	0.04	....
Molasses beet pulp	76.5	6.3	12.2	51.9	....	....
	76.0	6.1	12.6	51.4	....	....
Mixed feed No. 1	58.9	20.4	3.0	31.5	4.2	....
	59.0	19.8	3.3	31.7	4.1	....
Mixed feed No. 2	55.4	11.2	1.5	40.0	2.0	....
	55.4	10.9	1.7	39.8	1.9	....
Mixed feed No. 3	60.7	18.4	1.9	34.7	3.7	....
	61.6	18.1	2.0	35.5	3.9	....
Mixed feed No. 4	62.2	11.5	2.4	44.8	3.8	....
	61.9	10.9	2.4	44.7	3.9	....
Mixed feed No. 5	67.0	18.5	2.9	39.3	5.6	....
	67.6	18.3	2.9	40.0	5.5	....
Mixed feed No. 6	62.6	19.3	1.7	38.8	3.0	....
	62.5	20.4	1.6	38.2	2.7	....
Mixed feed No. 7	66.6	18.1	5.8	36.3	4.0	....
	66.5	16.5	6.0	37.8	3.3	....
Wheat bran	54.2	13.2	2.3	36.3	2.7	....
	53.1	12.1	2.6	35.9	2.1	....
Cottonseed meal	66.9	39.3	2.7	15.0	8.2	....
	69.6	39.9	2.6	16.8	8.9	....
Linseed meal (O. P.)	70.0	27.6	4.4	29.1	6.5	....
	71.0	27.3	4.5	30.7	5.5	....
Chicago gluten meal	81.0	32.2	...	41.9	3.9	....
	81.8	32.4	...	42.7	4.2	....
Hominy feed	78.6	8.2	2.7	60.4	5.8	....
	79.2	8.1	2.4	60.5	6.5	....
India wheat	56.8	7.9	...	45.9	1.1	....
	59.0	7.9	...	45.9	1.1	....

IV. FEEDING RECORDS OF INDIVIDUAL COWS

Very low and medium feeding Name of cow and period numbers	Nature of ration	Pounds eaten of								Pounds of digestible nutrients eaten during period					Nutritive ratio, 1:
		Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	Gluten meal	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	
STELLA															
II. Pre.	V. low	134	...	360	16	...	8	218.3	21.4	134.7	14.2	34.2	76.4	4.0	8.4
Exp.	"	265	...	690	30	...	15	405.8	40.0	262.7	27.5	67.2	149.0	7.9	8.5
III. Pre.	Med.	133	...	356	60	...	30	274.8	79.5	175.5	26.9	35.2	101.7	6.0	5.6
Exp.	"	254	...	689	122	...	62	540.9	164.7	346.2	54.1	73.7	198.2	11.1	5.5
IV. Pre.	V. low	133	...	359	15	...	8	220.2	20.2	135.2	13.4	37.4	75.7	3.7	9.0
Exp.	"	241	...	686	31	...	15	411.9	40.5	252.7	25.5	69.1	141.6	7.0	8.9
V. Pre.	Med.	127	...	359	64	...	32	272.1	83.9	177.7	28.1	37.5	101.9	5.7	6.4
Exp.	"	246	...	689	123	...	61	525.1	161.7	342.0	53.8	72.3	196.0	11.0	5.4
EUNICE															
II. Pre.	Med.	72	61	358	64	32	...	276.2	84.5	170.2	29.4	36.2	91.4	7.0	4.9
Exp.	"	138	116	690	121	61	...	519.5	160.3	325.3	55.8	69.3	164.8	13.5	4.7
III. Pre.	"	67	64	358	63	31	...	275.8	82.7	167.8	28.9	35.7	90.1	6.9	4.9
Exp.	"	130	123	686	122	61	...	536.7	163.6	324.7	56.0	69.2	173.0	13.8	4.9
IV. Pre.	"	98	33	360	64	32	...	281.5	83.2	172.5	29.0	37.2	92.5	7.3	5.0
Exp.	"	242	...	677	123	61	...	533.5	163.4	330.1	54.7	71.4	178.2	14.1	5.1
V. Pre.	"	129	...	360	64	32	...	271.3	83.9	174.0	28.7	37.8	94.0	7.3	5.2
Exp.	"	253	...	681	123	61	...	524.6	161.7	336.4	55.2	73.3	181.6	14.2	5.2
CONSTANCE															
I. Pre.	V. low	70	62	349	16	8	...	225.8	21.3	125.9	14.6	33.4	67.8	4.0	7.6
Exp.	"	138	113	683	31	15	...	414.5	40.4	242.9	28.0	64.5	130.8	7.6	7.6
II. Pre.	"	72	53	357	16	8	...	206.1	21.1	124.4	14.3	32.9	70.9	3.9	7.9
Exp.	"	138	103	678	31	15	...	386.1	40.5	238.1	27.4	63.1	128.4	7.5	7.6
III. Pre.	"	66	61	360	16	8	...	211.3	21.1	125.0	14.5	33.0	67.4	4.0	7.6
Exp.	"	128	119	686	31	15	...	409.1	41.1	241.1	28.6	63.9	128.2	8.0	7.3
IV. Pre.	"	98	35	358	16	8	...	220.4	20.8	130.6	15.0	34.9	69.9	4.4	7.6
Exp.	"	240	...	667	31	15	...	406.7	40.8	246.1	27.2	66.1	133.2	8.4	8.0
V. Pre.	"	136	...	358	16	8	...	214.1	21.0	135.4	14.9	36.6	73.2	4.6	8.1
Exp.	"	243	...	644	29	14	...	384.3	37.8	242.7	26.5	65.6	131.1	8.3	8.1
BEAUTINA															
I. Pre.	V. low	72	68	360	16	8	...	235.8	21.3	131.0	15.1	34.9	70.4	4.0	7.6
Exp.	"	138	134	690	31	15	...	434.2	40.4	252.7	29.0	67.5	135.6	8.0	7.7
II. Pre.	Med.	72	69	360	60	30	...	277.9	79.9	170.3	28.7	37.0	91.0	6.9	5.0
Exp.	"	138	131	689	123	61	...	533.9	162.1	332.6	57.0	71.2	178.4	13.7	4.9
III. Pre	V. low	70	68	360	16	8	...	220.6	21.1	130.0	15.0	34.5	69.9	4.0	7.6
Exp.	"	151	124	690	31	15	...	433.7	41.1	255.6	29.9	68.3	135.7	8.6	7.5
IV. Pre.	Med.	98	32	360	60	30	...	275.5	78.0	168.5	27.8	36.6	90.6	7.1	5.2
Exp.	"	239	...	688	123	61	...	533.5	163.4	330.1	54.6	71.4	178.3	14.1	5.2
LADY PERUSIA															
III. Pre.															
Exp.	V. low	342	...	690	31	...	15	493.3	41.2	303.8	32.7	82.3	165.5	9.5	8.0
IV. Pre.	"	180	...	360	16	...	8	261.9	21.1	159.3	17.1	42.9	86.8	4.9	8.2
Exp.	"	345	...	690	31	...	15	503.4	40.5	305.3	32.8	82.8	166.3	9.5	8.2
V. Pre.	"	177	...	360	16	...	8	253.8	21.0	157.8	17.0	42.8	86.0	4.9	8.2
Exp.	"	341	...	682	31	...	15	487.1	40.4	302.2	32.5	81.9	164.5	9.4	8.2

Very low and medium feeding		Pounds eaten of								Pounds of digestible nutrients eaten during period					
Name of cow and period numbers	Nature of ration	Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	Gluten meal	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
SERENA															
III. Pre.	V. low														
Exp.	"	329	...	684	29	...	15	478.9	39.4	295.0	31.5	80.1	160.4	9.2	7.3
IV. Pre.	Med.	165	...	352	60	...	30	305.2	79.2	191.8	29.9	41.5	107.3	7.0	5.5
Exp.	"	320	...	682	121	...	60	598.8	159.5	375.7	59.0	80.8	210.4	12.7	5.4
V. Pre.	V. low	124	...	360	16	...	8	249.3	21.0	155.2	16.7	42.0	84.7	4.9	8.3
Exp.	"	256	...	686	31	...	15	494.2	40.4	306.5	33.0	83.1	166.8	9.5	8.2
MINTA BELLA															
I. Pre.	Med.	72	64	359	64	32	...	295.9	85.2	171.6	29.6	36.3	92.1	7.0	4.9
Exp.	"	138	122	689	121	61	...	542.9	159.8	327.6	56.1	70.1	175.9	13.6	4.9
II. Pre.	"	72	59	360	63	32	...	274.1	83.6	169.2	29.2	36.0	90.9	6.9	4.9
Exp.	"	138	106	681	123	61	...	510.8	162.1	321.0	55.6	67.8	172.7	13.4	4.9
III. Pre.	"	66	61	359	62	31	...	271.8	81.8	165.5	28.6	35.1	89.0	6.9	4.9
Exp.	"	126	115	679	121	61	...	523.9	162.7	317.6	55.0	67.4	169.3	13.6	4.9
JUDITH															
I. Pre.	Med.	136	...	236	64	32	...	263.2	85.2	159.8	28.2	32.4	87.9	6.8	4.8
Exp.	"	255	...	449	121	60	...	486.0	158.9	301.4	52.5	60.9	165.1	12.8	4.9
II. Pre.	V. low	137	...	240	16	8	...	194.3	21.1	118.5	13.5	30.5	65.9	3.9	7.8
Exp.	"	256	...	459	30	15	...	350.5	39.6	223.2	25.4	57.4	124.0	7.3	7.8
III. Pre.	Med.	113	...	238	59	29	...	228.9	77.4	143.7	25.5	28.7	70.3	6.3	4.0
Exp.	"	246	...	457	123	61	...	480.8	164.5	302.7	50.5	66.2	155.2	12.5	5.7
LUCERNE															
II. Pre.	V. low	187	...	360	15	...	8	263.7	20.5	161.6	16.5	42.3	91.2	4.7	8.7
Exp.	"	357	...	689	31	...	15	484.6	40.9	310.2	31.9	80.9	175.0	9.2	8.7
III. Pre.	"	181	...	360	16	...	8	258.9	21.2	159.3	16.4	41.4	89.9	4.6	8.6
Exp.	"	348	...	690	31	...	15	498.5	41.2	309.3	29.8	87.5	172.3	8.5	9.4
IV. Pre.	"	171	...	360	16	...	8	254.1	21.1	155.9	15.5	43.6	87.0	4.2	9.3
Exp.	"	317	...	687	31	...	15	478.3	40.5	292.8	28.6	82.1	163.2	8.1	9.2
V. Pre.	"	178	...	356	16	...	8	253.9	21.0	159.1	15.3	44.9	88.6	4.4	9.4
Exp.	"	323	...	682	31	...	15	471.0	40.4	295.2	28.7	82.9	164.5	8.1	9.3
YUBA															
II. Pre.	Low	96	67	360	32	...	16	260.5	42.5	158.9	20.6	38.8	87.6	4.6	6.7
Exp.	"	184	165	690	61	...	31	522.6	81.8	319.4	41.0	78.8	174.9	9.7	6.7
III. Pre.	V. low	90	83	360	16	...	8	250.8	21.2	147.7	16.4	39.4	79.9	4.2	7.9
Exp.	"	173	164	690	31	...	15	485.5	41.2	285.6	33.5	75.9	152.5	8.8	7.4
IV. Pre.	Low	131	40	360	32	...	16	275.1	42.2	165.9	21.8	40.6	90.7	5.2	6.6
Exp.	"	342	...	683	60	...	30	538.0	79.3	330.5	41.6	82.7	181.7	10.2	7.0
V. Pre.	V. low	181	...	360	16	...	8	253.5	21.0	159.9	17.2	43.4	87.1	5.0	8.2
Exp.	"	349	...	689	30	...	15	487.9	39.6	306.7	32.8	83.4	166.9	9.6	8.3
LAVENDER															
I. Pre.	Low	189	...	360	32	16	...	298.3	42.6	176.6	22.0	43.6	96.7	6.0	7.1
Exp.	"	352	...	690	61	31	...	548.5	80.8	333.1	40.7	82.1	184.9	11.6	7.2
II. Pre.	"	186	...	360	32	16	...	284.5	42.2	175.0	21.9	43.1	97.1	6.0	7.0
Exp.	"	347	...	690	61	31	...	516.5	81.1	330.6	41.5	81.4	183.5	11.6	7.0
III. Pre.	"	175	...	360	32	16	...	274.8	42.2	169.4	21.4	41.5	94.0	5.9	7.0
Exp.	"	346	...	688	61	31	...	537.4	82.2	333.7	38.5	89.3	183.2	11.1	7.7
IV. Pre.	"	164	...	360	32	16	...	268.6	41.6	165.5	19.5	43.6	91.0	5.5	7.5
Exp.	"	333	...	690	61	31	...	534.1	81.7	326.9	38.0	87.2	179.3	10.9	7.7
V. Pre.	"	177	...	359	32	16	...	274.6	42.0	171.8	20.0	46.1	94.6	5.7	7.7
Exp.	"	322	...	687	61	31	...	511.7	80.9	321.0	37.6	85.2	176.2	10.8	7.6

V'y low, low and medium feeding Nos. 7 and 1 Name of cow and period numbers	Nature of ration	Pounds eaten of								Pounds of digestible nutrients eaten during period					Nutritive ratio, 1 :
		Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	Gluten meal or. beet pulp	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	
Ursula															
I. Pre.	Low	190	...	360	32	16	...	299.2	42.6	177.1	22.0	43.7	98.2	6.1	7.1
Exp.	"	354	...	690	61	30	...	549.4	79.9	333.5	41.5	82.3	185.3	11.6	7.1
II. Pre.	V. low	186	...	360	16	8	...	263.4	21.1	160.8	17.0	42.4	89.6	5.0	8.4
Exp.	"	332	...	690	31	15	...	463.2	40.5	295.8	31.3	77.8	164.8	9.3	8.4
III. Pre.	Low	163	...	360	32	16	...	264.4	42.2	163.3	20.8	39.7	90.6	5.7	6.9
Exp.	"	338	...	689	61	31	...	530.7	82.2	329.6	38.2	88.1	181.0	11.0	7.7
IV. Pre.	V. low	159	...	360	16	8	...	243.5	20.8	148.8	14.6	41.9	82.0	4.5	9.2
Exp.	"	310	...	690	31	15	...	473.2	40.8	285.5	30.8	78.1	153.9	9.7	8.2
V. Pre.	Low	159	...	360	32	16	...	258.8	42.0	162.9	19.3	43.0	89.6	5.5	7.5
Exp.	"	308	...	686	61	31	...	499.0	80.9	313.4	37.0	82.8	172.3	10.5	7.2
Elsa															
II. Pre.	Low	72	60	357	32	...	16	233.4	42.7	143.3	19.0	33.9	79.5	4.6	6.5
Exp.	"	138	114	689	60	...	31	438.2	80.9	274.2	36.2	65.1	152.3	8.6	6.5
III. Pre.	"	65	59	360	32	...	16	230.0	42.4	139.7	18.8	32.7	77.7	4.1	6.4
Exp.	"	126	113	684	60	...	30	441.1	80.5	266.5	37.2	62.7	146.1	9.1	6.2
IV. Pre.	"	97	28	352	32	...	16	233.5	42.2	142.0	19.6	33.7	78.5	4.5	6.2
Exp.	"	230	...	671	60	...	30	437.6	79.3	270.7	36.0	64.5	150.7	9.4	6.6
V. Pre.	"	108	...	350	30	...	15	206.9	39.3	133.7	17.8	31.9	74.9	4.3	6.5
Exp.	"	232	...	656	61	...	31	420.3	80.9	272.9	36.4	64.4	150.6	8.8	6.5
Vivian															
II. Pre.	V. low	72	57	360	16	...	8	210.3	21.4	127.4	14.3	33.2	69.9	3.6	7.8
Exp.	"	138	106	689	30	...	15	390.4	40.0	242.0	26.9	63.4	132.9	7.2	7.9
III. Pre.	Low	62	53	359	32	...	16	222.1	42.4	135.5	18.4	31.4	75.6	4.1	6.3
Exp.	"	115	92	688	61	...	30	415.6	81.4	253.1	35.9	58.6	139.6	8.2	6.0
IV. Pre.	V. low	89	24	360	16	...	8	203.9	21.1	122.4	14.0	31.6	67.1	3.7	7.6
Exp.	"	201	...	673	31	...	15	374.0	40.5	228.5	25.5	59.4	126.2	7.1	7.9
V. Pre.	Low	114	...	358	32	...	16	216.0	42.0	139.9	18.8	33.1	78.1	4.6	6.8
Exp.	"	230	...	666	61	...	31	420.7	80.9	271.2	36.4	64.4	150.9	8.9	6.5
Acme															
I. Pre.	No. 7	72	54	360	39	39	38	308.1	105.9	188.4	30.5	39.2	102.1	7.5	5.2
Exp.	"	138	121	688	77	77	76	588.8	206.8	373.1	60.6	77.6	201.8	15.1	5.2
II. Pre.	"	72	54	360	40	40	40	294.2	107.8	191.0	31.2	39.5	103.6	7.7	5.1
Exp.	"	138	76	671	77	77	76	528.1	207.0	351.9	58.1	71.4	190.4	14.5	5.1
III. Pre.	"	58	43	288	40	40	40	259.5	107.9	168.9	29.4	33.0	91.6	7.3	4.8
Exp.	"	115	91	461	74	75	74	483.8	202.5	311.8	51.8	61.4	170.5	12.1	5.0
IV. Pre.	"	80	15	186	39	40	39	232.1	106.0	152.6	25.9	29.0	84.2	6.1	4.9
Exp.	"	165	...	290	73	72	73	408.1	196.0	271.7	46.8	50.8	150.3	11.0	4.8
V. Pre.	"	74	...	140	37	37	36	192.4	98.8	131.4	23.0	23.5	72.0	5.1	4.6
Exp.	"	184	...	323	75	75	75	428.8	200.9	290.8	49.1	55.5	160.8	11.6	4.9
Atalanta															
I. Pre.	No. 7	72	61	360	39	39	38	314.3	105.9	191.3	30.9	40.0	103.5	9.6	5.2
Exp.	"	138	123	689	77	77	76	590.8	206.8	344.0	60.7	78.0	223.0	15.2	5.1
II. Pre.	No. 1	72	58	360	76	40	4	295.5	105.8	184.3	33.9	36.9	98.0	7.9	4.5
Exp.	"	138	110	690	157	77	...	556.7	202.6	351.0	65.3	70.0	188.8	15.5	4.5
III. Pre.	No. 7	64	55	359	42	41	37	291.0	107.9	187.1	30.9	38.3	101.6	7.6	5.1
Exp.	"	124	110	682	77	77	76	564.7	208.8	360.0	63.7	74.3	198.4	13.6	5.4
IV. Pre.	No. 1	93	26	355	76	40	4	273.1	86.3	181.0	32.9	36.3	96.6	8.1	4.5
Exp.	"	225	...	654	153	77	...	554.1	204.2	345.2	62.6	69.3	186.3	15.6	4.6
V. Pre.	No. 7	109	...	353	42	40	36	274.4	105.8	184.7	28.4	38.3	102.4	7.0	5.5
Exp.	"	235	...	650	77	77	76	546.2	205.4	366.5	55.6	76.9	203.8	14.0	5.6

Nos. 1 and 7; dried molasses beet pulp		Pounds eaten of								Pounds of digestible nutrients eaten during period					
Name of cow and period numbers	Nature of ration	Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	Beet pulp	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
Elizabeth															
I. Pre.	No. 1	48	43	240	64	32	...	226.0	85.2	133.4	26.3	25.5	71.6	6.1	4.2
Exp.	"	92	88	460	123	61	...	422.9	161.6	258.3	50.5	49.4	138.5	11.8	4.3
II. Pre.	"	48	41	240	64	32	...	212.9	84.5	132.5	26.2	25.2	71.2	6.1	4.2
Exp.	"	92	84	455	120	60	...	402.7	158.6	253.5	49.5	48.5	136.0	11.5	4.3
III. Pre.	"	46	45	239	64	32	...	216.4	84.5	133.1	26.3	25.3	71.3	6.1	4.2
Exp.	"	89	86	460	123	61	...	419.2	164.5	256.4	49.9	49.3	136.5	11.7	4.3
IV. Pre.	"	67	25	240	64	32	...	219.5	83.2	136.0	26.0	26.5	72.8	6.3	4.4
Exp.	"	169	...	460	123	61	...	418.9	163.4	261.4	49.0	51.2	141.1	12.0	4.5
V. Pre.	"	82	...	239	64	32	...	205.2	83.9	133.0	25.2	25.8	71.9	6.2	4.4
Exp.	"	174	...	460	123	61	...	409.5	161.7	264.0	49.2	52.0	142.4	12.1	4.5
Santa Clara															
I. Pre.	No. 1	48	40	360	64	32	...	254.2	85.2	149.1	37.3	29.7	81.0	6.4	4.6
Exp.	"	92	80	690	123	61	...	469.4	161.6	287.7	52.3	57.3	156.0	12.6	4.6
II. Pre.	No. 7	48	38	360	34	32	30	238.7	86.2	155.9	24.6	32.2	85.2	5.8	5.3
Exp.	"	92	74	685	62	61	61	448.0	165.6	298.7	47.8	61.6	163.2	12.1	5.3
III. Pre.	No. 1	44	41	360	62	32	2	238.6	84.6	148.2	27.1	29.3	80.4	6.5	4.6
Exp.	"	81	71	689	123	61	...	452.0	164.5	278.4	50.9	55.3	150.1	12.5	4.6
IV. Pre.	No. 7	55	17	355	34	31	29	230.4	84.2	148.1	22.7	30.5	82.2	5.6	5.5
Exp.	"	136	...	663	60	60	59	435.2	160.8	283.5	42.4	58.7	158.0	10.8	5.7
V. Pre.	No. 1	75	...	351	62	32	2	222.8	84.1	145.8	25.8	29.3	79.0	6.5	4.8
Exp.	"	148	...	676	123	61	...	432.1	161.7	281.2	50.1	56.5	152.9	12.6	4.8
Mona															
II. Pre.	No. 1	138	101	687	123	61	...	508.0	162.1	320.4	55.4	67.9	171.0	13.7	4.9
III. Pre.	No. 7	64	55	342	30	30	30	260.2	80.9	164.7	25.3	35.8	89.3	6.4	5.5
Exp.	"	126	114	689	62	62	61	529.8	167.1	333.7	49.5	72.6	181.8	12.2	5.7
IV. Pre.	No. 1	93	31	358	62	32	2	275.2	83.4	169.2	28.5	36.2	90.5	7.2	5.0
Exp.	"	227	...	675	123	61	...	519.9	163.4	322.0	53.8	69.0	174.0	13.8	5.1
V. Pre.	No. 7	118	...	355	34	31	29	261.2	84.3	173.5	24.8	38.3	95.7	6.4	6.0
Exp.	"	255	...	674	62	61	61	527.6	164.3	350.1	49.2	78.2	192.8	12.9	6.1
Orpha															
I. Pre.	No. 7	72	64	275	32	32	32	276.8	87.6	167.0	26.4	36.0	89.7	6.1	5.3
Exp.	"	138	119	690	62	61	61	546.3	165.4	341.8	52.2	74.9	184.9	13.3	5.6
II. Pre.	"	72	62	360	32	32	32	279.2	86.2	178.3	27.2	39.1	96.4	6.4	5.5
Exp.	"	138	96	690	62	61	61	507.7	165.6	332.2	51.0	72.0	180.3	13.1	5.5
III. Pre.	"	60	47	360	32	32	32	259.2	86.3	165.8	26.0	35.2	90.2	6.1	5.4
Exp.	"	123	107	687	61	60	60	517.9	164.3	327.0	48.4	71.1	178.6	12.1	5.7
Alta															
I. Pre.	Pulp	142	...	120	57	28	24	251.4	22.5	157.7	26.8	31.4	89.1	6.1	5.0
Exp.	"	257	...	...	115	57	197	559.4	183.8	333.6	59.3	67.5	228.4	10.8	5.4
II. Pre	"	138	...	...	61	31	102	294.4	92.9	202.9	31.5	35.8	120.5	5.8	5.4
Exp.	"	242	...	...	115	57	194	538.0	181.0	373.6	58.4	65.0	222.5	10.6	5.3
III. Pre.	"	119	...	...	63	32	110	290.9	104.2	202.3	31.8	34.0	120.3	5.7	5.3
Exp.	"	247	...	...	121	61	197	559.7	184.6	386.8	57.9	72.8	229.1	10.7	5.6
IV. Pre.	"	107	...	...	61	30	105	270.5	99.2	191.2	28.7	34.4	113.2	5.1	5.6
Exp.	"	200	...	...	114	57	200	511.4	185.2	357.9	54.1	64.8	213.8	9.6	5.6
V. Pre.	"	103	...	...	62	31	104	267.5	94.7	188.0	28.8	33.7	112.3	5.1	5.5
Exp.	"	197	...	...	99	50	213	501.6	194.9	353.2	50.4	65.2	212.6	8.7	5.9

Dried molasses beet pulp and corn silage		Pounds eaten of								Pounds of digestible nutrients eaten during period					
Name of cow and period numbers	Nature of ration	Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	Beet pulp	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
ADELAIDE															
I. Pre.	Pulp	139	...	120	63	32	*24	257.7	22.5	168.8	28.5	31.2	91.3	6.4	4.8
Exp.	"	264	...	...	123	61	220	597.6	205.3	411.9	63.5	50.8	246.1	11.4	5.4
II. Pre.	Silage	140	...	339	64	32	9	290.2	83.5	183.6	29.9	38.1	102.2	7.4	5.3
Exp.	"	240	...	689	119	59	...	501.2	140.6	326.2	53.9	68.0	180.5	13.7	5.2
III. Pre.	Pulp	125	...	...	64	32	116	302.7	109.9	209.2	32.6	35.7	125.4	5.8	5.3
Exp.	"	247	...	...	120	61	217	577.5	203.3	401.4	59.0	75.0	239.0	10.6	5.9
IV. Pre.	Silage	108	...	335	64	32	25	279.5	103.0	179.7	27.9	38.2	101.1	6.6	5.5
Exp.	"	204	...	672	120	61	...	496.5	157.9	309.4	50.3	67.6	169.7	12.8	5.3
V. Pre.	Pulp	120	...	21	62	31	100	283.4	95.5	196.9	29.5	36.9	116.7	5.5	5.6
Exp.	"	235	...	...	108	54	223	556.0	204.0	388.5	55.1	73.4	232.7	9.7	6.0

*Pulp late in arriving.

Name of cow and period numbers	Nature of ration	Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	Beet pulp	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
NANCY B.															
I. Pre.	Silage	72	34	360	77	39	...	287.7	92.2	171.0	32.2	33.5	92.5	7.6	4.5
Exp.	"	138	77	690	153	77	...	546.6	160.1	337.3	63.7	65.8	182.2	15.5	4.4
II. Pre.	Pulp	72	19	...	79	39	120	290.8	109.3	206.2	36.0	32.1	123.1	6.1	4.7
Exp.	"	138	37	...	153	77	230	568.0	214.6	397.8	69.6	62.0	236.3	11.9	4.7
III. Pre.	Silage	58	44	360	80	39	...	273.4	81.0	169.8	32.7	32.5	91.7	7.7	4.3
Exp.	"	105	72	682	153	77	...	512.7	156.2	317.4	61.0	60.4	170.6	14.7	4.3
IV. Pre.	Pulp	94	10	25	80	40	112	305.5	111.7	212.4	36.0	34.3	124.9	6.5	4.8
Exp.	"	157	...	...	153	77	230	554.1	213.0	391.9	67.2	61.4	233.3	11.9	4.8
V. Pre.	Silage	91	...	340	80	40	7	261.5	77.7	166.2	31.5	32.0	90.0	7.8	4.4
Exp.	"	154	...	628	153	77	...	467.8	131.3	304.7	58.9	57.0	165.1	14.4	4.3
UNA															
I. Pre.	Pulp	48	40	80	61	31	80	253.8	74.9	168.2	28.8	28.6	97.9	5.2	4.8
Exp.	"	92	80	...	121	61	230	522.1	214.6	363.9	59.8	58.5	217.4	9.8	5.0
II. Pre.	Silage	48	44	240	64	32	...	215.4	84.5	133.8	26.3	25.6	71.8	6.1	4.2
Exp.	"	92	88	459	123	61	...	410.4	93.6	258.1	50.5	49.3	138.4	11.7	4.2
III. Pre.	Pulp	44	39	...	64	32	118	267.5	111.7	185.7	30.4	29.3	111.0	5.0	4.9
Exp.	"	84	75	...	122	60	226	510.3	211.8	354.4	58.1	57.1	211.9	9.7	5.0
IV. Pre.	Silage	65	28	225	64	32	8	224.4	60.9	140.2	26.4	27.0	75.7	6.1	4.4
Exp.	"	167	...	460	123	61	...	417.1	108.1	260.4	48.9	50.9	140.5	12.0	4.5
V. Pre.	Pulp	72	...	15	63	31	112	249.8	105.2	180.0	29.0	29.2	108.0	5.1	5.1
Exp.	"	164	...	...	123	61	218	504.2	199.5	359.3	57.7	59.5	214.5	10.1	5.1
SURPRISE															
I. Pre.	Pulp	48	36	80	62	32	78	250.2	73.0	166.1	28.9	27.7	96.8	5.2	4.7
Exp.	"	92	69	...	119	60	230	510.0	214.6	357.5	58.7	57.0	214.3	9.5	5.0
II. Pre.	"	48	35	...	62	31	117	258.6	106.6	183.5	30.4	29.3	109.9	4.9	4.9
Exp.	"	92	59	...	123	61	225	501.9	209.9	352.5	58.9	55.3	211.3	9.5	4.9
III. Pre.	"	42	37	...	64	32	120	266.0	113.6	185.4	31.0	28.9	111.2	5.0	4.9
Exp.	"	82	72	...	123	61	223	505.0	209.0	351.1	58.0	56.1	209.3	9.7	4.9
IV. Pre.	"	62	18	...	63	32	117	262.1	110.6	184.7	29.9	29.8	110.5	5.1	5.1
Exp.	"	141	...	...	99	50	181	422.9	167.6	299.5	46.1	51.7	177.5	7.9	5.4
V. Pre.	"	83	...	...	62	31	101	245.3	92.0	175.1	27.9	29.9	105.0	4.9	5.2
Exp.	"	159	...	...	122	61	210	491.7	192.2	351.1	55.4	59.5	211.1	9.6	5.3

*Sick.

Nos. 3 and 1		Pounds eaten of								Pounds of digestible nutrients eaten during period					
Name of cow and period numbers	Nature of ration	Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	India wheat	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
SONOMA															
II. Pre.	No. 3														
Exp.	“	138	105	681	62	61	61	506.5	158.6	323.9	52.0	65.6	178.3	12.5	5.2
III. Pre.	“	66	59	358	32	32	32	270.3	82.2	168.1	27.1	33.9	92.5	6.5	5.2
Exp.	“	127	116	687	62	61	61	527.7	163.0	325.7	52.5	65.7	178.1	13.4	5.2
IV. Pre.	“	92	30	356	32	32	32	273.3	83.6	170.1	27.0	34.4	93.5	7.0	5.3
Exp.	“	247	...	688	62	61	61	538.1	161.0	338.9	51.9	70.2	187.4	14.0	5.6
V. Pre.	“	124	...	360	32	32	32	266.8	83.7	174.4	26.9	35.9	96.7	7.1	5.5
Exp.	“	245	...	678	61	61	60	515.6	160.3	334.8	51.3	69.3	185.1	13.7	5.6
CERES															
II. Pre.	No. 3														
Exp.	“	138	123	683	123	61	...	525.8	162.1	328.4	56.6	59.9	176.3	13.6	4.9
III. Pre.	No. 1	70	68	360	34	32	30	281.8	82.3	174.1	27.8	35.6	95.6	6.6	5.3
Exp.	“	131	126	690	62	61	61	540.4	163.0	332.2	53.3	67.6	181.3	13.6	5.2
IV. Pre.	No. 3	102	42	360	62	32	2	292.8	83.3	178.5	29.8	38.5	95.6	7.4	5.1
Exp.	“	239	...	680	120	60	...	528.0	159.8	326.7	53.7	70.9	176.5	13.9	5.2
V. Pre.	No. 1	135	...	360	34	32	30	276.4	83.8	179.9	27.5	37.7	99.4	7.3	5.6
Exp.	“	260	...	688	62	61	61	531.7	161.2	345.7	52.5	72.3	190.9	14.2	5.6
MAID MARIAN															
II. Pre.	No. 1	72	59	360	61	31	...	271.5	81.0	167.4	28.7	35.9	90.0	6.8	4.9
Exp.	“	138	120	690	121	60	...	522.1	159.5	326.4	55.8	69.7	175.3	13.5	4.9
III. Pre.	“	68	66	360	64	32	...	280.6	84.5	170.6	29.6	36.4	91.8	7.0	4.9
Exp.	“	130	122	686	123	61	...	536.8	164.5	324.9	56.1	69.0	173.1	13.7	4.9
IV.	“	97	31	359	64	32	...	278.7	83.2	170.9	28.4	36.7	91.7	7.3	5.0
Exp.	“	248	...	689	123	61	...	541.5	163.4	334.9	55.1	72.9	180.8	14.3	5.2
V. Pre.	“	126	...	359	64	32	...	268.5	83.9	172.8	28.6	37.5	93.4	7.3	5.2
Exp.	“	252	...	686	123	61	...	524.8	161.7	336.5	55.2	73.3	181.7	14.2	5.2
ROSEMARY															
II. Pre.	No. 3														
Exp.	“	249	...	687	62	61	61	510.1	158.6	337.4	52.0	67.4	190.5	13.0	5.5
III. Pre.	No. 1	127	...	360	62	32	2	275.3	84.3	173.1	28.8	35.7	96.0	7.2	5.1
Exp.	“	252	...	690	123	61	...	539.2	164.5	338.7	53.0	76.5	185.8	13.6	5.5
IV. Pre.	No. 3	128	...	359	34	31	29	277.7	82.0	175.9	25.6	38.2	98.6	6.7	5.9
Exp.	“	241	...	688	62	61	61	532.9	161.0	337.5	49.4	72.2	189.5	13.1	5.9
V. Pre.	No. 1	126	...	360	62	32	2	271.4	83.9	174.1	27.3	38.9	95.8	6.9	5.5
Exp.	“	234	...	688	123	61	...	514.2	161.7	329.1	52.3	73.4	180.5	13.3	5.4
MAX BELLE															
I. Pre.	No. 3	72	62	275	32	32	32	270.9	83.5	160.5	26.9	32.0	87.8	6.3	5.0
Exp.	“	138	118	681	62	61	61	536.5	158.6	329.3	52.6	67.3	180.9	12.6	5.3
II. Pre.	“	72	57	359	32	32	32	271.9	83.2	170.4	27.4	34.6	93.8	6.5	5.2
Exp.	“	138	86	638	62	61	61	481.5	158.6	309.7	50.6	61.6	171.0	12.1	5.1
III. Pre.	“	61	50	345	32	32	31	254.3	81.3	159.3	26.1	31.5	87.9	6.3	5.1
Exp.	“	125	112	678	61	60	60	515.0	160.4	320.0	51.6	64.4	174.9	13.2	5.2
IV. Pre.	“	95	28	330	32	32	32	267.9	83.6	167.0	26.8	33.6	91.9	6.8	5.3
Exp.	“	197	...	609	62	61	61	475.9	161.0	301.8	48.7	59.2	167.6	14.8	5.3
V. Pre.	“	102	...	328	32	32	32	241.0	83.7	158.5	25.5	31.1	88.1	6.6	5.2
Exp.	“	200	...	617	59	59	59	459.3	155.9	300.2	47.6	59.8	166.6	12.6	5.4

Nos. 3 and 1 Nos. 2 and 1		Pounds eaten of								Pounds of digestible nutrients eaten during period					
Name of cow and period numbers	Nature of ration	Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	India wheat	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
MURIEL															
I. Pre.	No. 3	48	23	239	24	23	23	184.1	60.9	111.0	18.6	21.4	61.5	4.5	5.0
Exp.	“	92	67	460	46	46	45	361.3	118.1	224.3	37.2	43.9	123.8	8.9	5.1
II. Pre.	No. 1	48	30	240	48	24	2	184.4	65.0	114.9	20.3	23.1	62.3	4.9	4.7
Exp.	“	92	57	454	87	44	...	336.2	115.4	213.2	38.2	43.6	115.1	9.1	4.7
III. Pre.	No. 3	41	33	240	26	24	22	179.3	61.7	112.9	19.2	21.6	62.3	4.7	4.9
Exp.	“	75	58	453	45	45	45	336.8	119.6	210.9	35.6	39.9	116.3	9.0	5.0
IV. Pre.	No. 1	53	7	239	47	23	2	170.9	62.5	107.0	19.4	21.2	58.1	4.9	4.7
Exp.	“	112	...	451	92	46	...	326.2	122.5	203.4	37.0	40.3	111.1	9.3	4.6
V. Pre.	No. 3	70	...	239	26	24	22	173.7	62.8	114.5	18.7	22.2	62.6	4.9	5.1
Exp.	“	153	...	449	45	45	44	345.3	118.1	225.6	36.0	44.9	125.2	9.4	5.3
EVA															
I. Pre.	No. 2	72	61	360	59	4	32	285.8	77.4	164.4	20.1	34.7	97.8	4.8	7.1
Exp.	“	138	121	690	120	2	62	539.8	157.2	322.8	40.2	67.2	191.7	9.7	7.0
II. Pre.	“	72	62	360	64	...	32	275.1	82.1	167.6	20.7	34.9	100.0	4.9	7.1
Exp.	“	138	102	683	119	...	59	497.0	151.3	309.8	37.9	64.5	185.3	9.2	7.1
III. Pre.	“	67	63	357	61	...	30	269.3	77.3	162.2	19.9	34.1	96.6	4.8	7.7
Exp.	“	127	117	686	121	...	60	523.4	158.0	313.0	39.0	65.1	185.0	9.5	7.0
IV. Pre.	“	90	31	360	64	...	32	270.2	80.6	164.0	20.0	33.7	97.7	5.0	7.1
Exp.	“	234	...	676	121	...	60	516.7	153.8	317.5	37.6	67.1	189.7	9.8	7.4
V. Pre.	“	119	...	360	64	...	32	260.4	81.6	165.9	19.7	34.5	99.4	5.1	7.4
Exp.	“	230	...	672	120	...	...	495.5	154.5	314.3	37.2	66.3	187.9	9.8	7.4
MERMAID															
I. Pre.	No. 2	135	...	360	60	4	32	290.8	81.8	174.1	20.9	35.6	105.8	5.3	7.3
Exp.	“	265	...	690	120	2	62	548.9	157.2	337.0	40.0	69.2	204.7	10.3	7.5
II. Pre.	No. 1	141	...	360	62	32	2	287.3	84.3	180.0	29.1	37.8	100.2	7.3	5.3
Exp.	“	270	...	689	123	61	...	531.9	162.1	345.1	56.5	72.8	190.8	14.3	5.2
III. Pre.	No. 2	134	...	360	64	2	30	278.8	81.8	173.5	21.0	35.6	105.3	5.4	7.6
Exp.	“	257	...	690	123	...	61	539.6	160.6	334.6	36.9	74.4	202.3	9.6	8.1
IV. Pre.	No. 1	132	...	360	64	32	2	282.3	83.0	176.8	27.2	39.6	97.8	6.9	5.6
Exp.	“	240	...	690	123	61	...	534.7	163.4	332.4	52.5	74.5	182.4	13.4	5.5
V. Pre.	No. 2	130	...	360	64	2	30	272.9	81.9	172.8	19.6	37.9	103.8	5.0	7.8
Exp.	“	239	...	687	123	...	61	514.7	157.9	323.3	38.3	68.4	193.1	10.1	7.4
EDITH															
I. Pre.	No. 1	72	62	274	64	32	...	272.3	85.2	158.6	28.6	33.1	84.6	6.7	4.6
Exp.	“	138	119	690	123	61	...	542.5	161.6	327.7	56.4	69.7	176.1	13.6	4.9
II. Pre.	“	72	63	360	64	32	...	278.3	84.5	171.3	29.6	36.5	92.0	7.0	4.9
Exp.	“	138	111	685	123	61	...	515.9	162.1	323.7	56.0	68.5	174.1	13.4	4.9
III. Pre.	“	62	52	294	47	24	...	226.7	62.5	137.4	22.8	30.0	73.7	5.6	5.1
Exp.	“	124	110	622	113	57	...	494.1	152.0	299.3	51.9	63.7	159.5	12.8	4.9
ELEANOR															
I. Pre.	No. 1	72	65	358	63	31	...	294.6	83.4	170.8	29.2	36.6	91.6	6.9	4.9
Exp.	“	138	130	690	123	61	...	551.9	161.6	332.3	56.9	71.1	178.3	13.7	4.9
II. Pre.	No. 2	72	68	359	64	2	30	279.8	82.1	170.1	21.5	35.8	100.6	5.1	6.9
Exp.	“	138	122	690	123	...	61	520.7	156.4	322.5	39.6	67.4	192.3	9.6	7.1
III. Pre.	No. 1	69	67	360	64	30	2	282.2	84.3	171.3	29.2	36.4	90.4	6.8	4.9
Exp.	“	131	124	686	120	60	...	535.7	160.9	324.0	55.4	69.4	172.5	13.7	4.9
IV. Pre.	No. 2	94	28	357	62	2	29	268.2	78.3	162.9	20.3	34.4	96.2	5.1	7.0
Exp.	“	240	...	669	120	...	60	519.4	153.0	319.0	37.6	67.8	190.3	9.9	7.5
V. Pre.	No. 1	126	...	355	64	30	...	246.6	83.8	172.1	28.0	37.2	93.8	7.2	5.3
Exp.	“	229	...	674	123	61	...	502.3	161.7	322.9	53.9	69.2	174.5	13.9	5.1

Nos. 2 and 1 Nos. 4 and 1		Pounds eaten of								Pounds of digestible nutrients eaten during period					
Name of cow and period numbers	Nature of ration	Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	India wheat or hominy feed	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
Queenie															
I. Pre.	No. 2	48	39	233	46	2	24	196.9	61.4	114.4	14.9	22.9	68.5	3.4	6.7
Exp.	“	92	72	458	91	2	44	364.2	117.1	219.1	28.0	43.9	131.6	6.6	6.8
II. Pre.	“	48	43	236	48	...	24	190.7	61.6	116.2	14.8	23.5	69.9	3.4	6.8
Exp.	“	92	80	458	91	...	46	357.8	116.5	222.1	31.9	45.7	133.7	6.6	5.1
III. Pre.	“	44	39	240	48	...	24	186.5	61.2	113.1	14.4	22.5	68.3	3.4	6.8
Exp.	“	86	79	460	92	...	46	366.7	120.5	219.7	27.9	44.1	130.9	6.7	6.8
Linnet															
I. Pre.	No. 2	48	35	232	42	3	22	189.0	57.1	108.7	13.9	22.2	65.3	3.3	6.8
Exp.	“	92	70	438	85	2	44	352.7	112.0	212.1	27.0	42.7	127.2	6.4	6.9
II. Pre.	No. 1	48	41	240	47	22	2	190.7	62.3	117.6	20.7	24.4	63.9	4.9	4.4
Exp.	“	92	74	458	91	46	...	356.8	120.7	224.4	40.2	46.2	120.7	9.6	4.7
III. Pre.	No. 2	44	41	240	45	2	21	184.9	57.9	111.8	14.5	22.7	66.6	3.6	6.7
Exp.	“	84	76	455	89	...	45	357.7	117.0	214.4	27.3	43.2	127.7	6.5	6.8
IV. Pre.	No. 1	63	18	238	46	22	2	186.8	60.5	115.2	19.7	23.9	62.4	3.0	5.0
Exp.	“	157	...	450	92	46	...	365.1	122.5	226.6	39.2	47.4	122.4	10.0	4.9
V. Pre.	No. 2	85	...	236	47	2	22	183.9	60.6	116.9	14.6	24.1	69.9	3.9	7.0
Exp.	“	160	...	456	90	...	45	392.4	115.8	222.5	26.8	45.8	133.6	7.0	7.3
Flora															
I. Pre.	No. 4	72	67	360	64	...	32	297.8	84.2	175.6	21.1	37.6	105.2	6.6	7.5
Exp.	“	138	118	690	123	...	61	541.6	161.6	333.3	40.0	68.5	200.3	12.9	7.4
II. Pre.	“	72	49	360	64	...	32	266.4	84.1	168.1	20.7	34.1	101.6	6.4	7.3
Exp.	“	138	99	690	123	...	61	505.8	161.2	325.4	39.1	66.1	196.5	12.7	7.4
III. Pre.	“	61	50	359	64	...	32	260.0	83.8	162.7	19.7	32.5	98.7	6.4	7.4
Exp.	“	121	103	684	122	...	61	510.5	162.7	316.7	38.0	63.7	190.1	12.9	7.4
IV. Pre.	“	90	32	347	63	...	32	270.1	82.7	168.2	19.9	34.4	101.1	7.1	7.1
Exp.	“	197	...	672	122	...	61	488.9	159.2	310.8	35.9	62.4	189.2	13.0	7.8
V. Pre	“	108	...	358	64	...	32	252.8	84.0	166.1	19.2	33.7	101.0	6.8	7.8
Exp.	“	207	...	649	122	...	61	475.3	159.2	312.7	36.1	63.1	190.1	13.0	7.8
Rosel															
I. Pre	No. 4	134	...	360	80	...	40	313.3	105.2	194.7	23.5	36.9	121.2	7.9	7.5
Exp.	“	244	...	688	152	...	76	573.1	200.2	365.1	44.0	68.7	227.5	14.9	7.5
II. Pre.	No. 1	123	...	357	79	38	3	292.2	105.5	185.0	33.2	35.8	103.0	8.2	4.7
Exp.	“	211	...	684	152	77	...	520.3	201.7	340.7	57.0	65.0	188.0	15.3	5.0
III. Pre.	No. 4	89	...	360	78	3	37	261.2	103.1	170.2	21.8	30.2	106.7	7.1	7.0
Exp.	“	192	...	690	153	...	77	527.6	204.5	341.0	39.3	65.7	213.2	14.3	7.9
IV. Pre	No. 1	73	...	357	79	38	3	251.8	104.1	160.7	29.5	29.6	78.7	7.2	4.2
Exp.	“	101	...	690	153	77	...	454.3	204.2	286.5	56.0	52.4	151.5	13.5	4.3
V. Pre.	No. 4	72	...	360	80	3	37	244.5	105.0	162.9	20.1	29.3	102.5	7.0	7.3
Exp.	“	138	...	682	153	...	77	465.7	200.1	311.7	37.0	56.3	197.2	13.5	7.7
Juanita															
I. Pre.	No. 1	48	42	359	64	32	...	255.7	85.2	150.1	27.4	30.1	81.2	6.5	4.6
Exp.	“	92	67	613	106	53	...	418.3	139.6	256.7	46.3	52.0	139.7	11.2	4.7
II. Pre.	“	48	35	360	64	32	...	234.6	84.5	147.2	27.1	29.1	80.0	6.4	4.6
Exp.	“	92	67	683	123	61	...	438.2	162.1	281.4	51.7	55.4	152.8	12.3	4.6
III. Pre.	“	43	38	357	64	32	...	234.4	84.5	145.6	26.9	28.6	79.0	6.4	4.5
Exp.	“	83	75	686	123	61	...	456.5	164.5	280.7	51.2	55.9	150.9	12.4	4.6
IV. Pre.	“	59	9	355	64	32	...	246.0	83.2	141.4	25.7	27.8	76.8	6.3	4.6
Exp.	“	149	...	684	121	61	...	452.2	161.6	281.7	49.7	56.9	153.2	12.6	4.8
V. Pre.	“	74	...	356	64	32	...	222.9	83.9	145.5	25.9	29.1	79.1	6.5	4.7
Exp.	“	152	...	656	119	59	...	426.1	156.5	276.8	48.8	56.1	150.3	12.3	4.8

Nos. 1 and 4 Nos. 4 and 6 Name of cow and period numbers	Nature of ration	Pounds eaten of								Pounds of digestible nutrients eaten during period					Nutritive ratio, 1 :
		Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	Hominy feed	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	
POMONA															
II. Pre.	No. 1	129	...	360	64	32	...	277.0	84.5	174.0	29.0	36.1	96.2	7.2	5.1
Exp.	"	225	...	682	123	61	...	492.2	162.1	321.1	54.5	65.6	177.6	13.6	5.0
III. Pre.	No. 4	104	...	358	64	2	30	254.6	83.9	163.9	19.8	31.9	101.0	6.6	7.5
Exp.	"	235	...	685	123	...	61	522.6	163.6	334.6	35.9	71.8	204.4	13.0	8.5
IV. Pre.	No. 1	119	...	358	64	30	2	270.8	83.2	170.1	26.7	37.6	94.2	6.8	5.5
Exp.	"	229	...	690	123	61	...	525.2	163.4	326.6	52.1	72.6	179.2	13.3	5.4
V. Pre.	No. 4	122	...	360	64	2	30	267.9	84.0	174.4	19.3	47.2	105.9	6.7	8.2
Exp.	"	212	...	684	123	...	61	492.2	160.1	322.3	35.0	67.8	197.8	12.7	8.4
MAYFAIR															
II. Pre.	No. 1														
Exp.	"	92	75	454	90	45	...	355.1	118.9	223.1	39.9	46.1	119.9	9.5	4.7
III. Pre.	No. 4	43	39	231	46	2	21	182.7	60.3	114.1	14.6	22.6	68.9	4.5	7.0
Exp.	"	84	76	460	92	...	46	364.6	122.7	226.3	27.7	44.4	136.6	9.4	8.0
IV. Pre.	No. 1	63	22	240	48	24	2	192.7	62.5	118.6	20.4	24.6	61.9	5.2	4.8
Exp.	"	157	...	457	91	46	...	366.0	121.7	227.0	39.1	47.6	122.6	9.9	4.9
V. Pre.	No. 4	87	...	236	47	2	22	187.2	62.2	129.1	14.7	24.9	73.6	5.2	7.5
Exp.	"	161	...	457	92	...	46	356.0	120.1	233.7	27.2	47.0	142.0	9.8	7.8
HALLOWE'EN															
II. Pre.	No. 4	136	...	359	64	...	32	282.5	84.1	180.0	20.7	36.6	110.5	6.9	7.9
Exp.	"	228	...	680	123	...	61	493.5	161.2	328.3	38.2	64.9	202.6	12.9	7.8
III. Pre.	"	114	...	358	64	...	32	263.1	83.8	168.7	19.5	33.3	104.2	6.6	7.8
Exp.	"	224	...	674	121	...	60	507.8	160.9	325.3	35.0	69.7	197.1	12.7	8.5
IV. Pre.	"	111	...	360	64	...	32	264.8	83.6	168.8	18.3	34.2	103.6	6.5	8.3
Exp.	"	205	...	686	123	...	61	499.3	160.1	318.7	34.8	66.7	196.0	12.6	8.4
V. Pre.	"	121	...	352	63	...	31	263.7	82.3	171.7	18.3	37.0	104.9	6.7	8.6
Exp.	"	220	...	672	121	...	60	494.1	157.5	323.0	34.8	68.6	198.8	12.7	8.5
INEZ															
II. Pre.	No. 6	72	68	360	64	32	...	283.3	85.4	177.2	28.7	35.8	100.1	5.9	5.2
Exp.	"	138	132	688	123	61	...	536.1	163.6	340.1	55.0	68.8	191.9	11.6	5.2
III. Pre.	No. 4	69	66	360	64	2	30	280.9	83.9	174.4	21.6	35.8	104.2	6.6	7.2
Exp.	"	131	126	690	123	...	61	541.0	163.6	332.8	40.1	68.3	198.2	13.6	7.4
IV. Pre.	No. 6	94	34	360	64	30	2	280.1	84.4	174.2	29.0	34.7	98.3	6.5	5.1
Exp.	"	254	...	686	123	61	...	544.8	162.1	344.0	56.4	70.4	194.2	11.8	5.2
V. Pre.	No. 4	130	...	359	64	2	30	272.0	83.9	177.8	20.8	37.1	106.6	7.2	7.7
Exp.	"	252	...	675	123	...	61	520.9	160.1	340.3	38.7	71.2	204.7	13.9	7.9
FRESNO															
I. Pre.	No. 4	72	64	360	64	...	32	295.2	84.2	174.4	20.9	36.0	104.6	6.6	7.3
Exp.	"	138	126	690	123	...	61	548.5	161.6	336.7	40.4	69.5	201.9	13.0	7.4
II. Pre.	No. 6	72	67	360	64	30	2	282.5	85.4	176.7	28.3	35.7	100.3	5.9	5.3
Exp.	"	138	123	690	123	61	...	528.8	163.6	336.6	54.6	67.8	190.3	11.5	5.2
III. Pre.	No. 4	69	65	360	64	2	30	280.1	83.9	174.0	21.6	35.6	104.0	6.6	7.2
Exp.	"	127	117	690	123	...	61	529.9	163.6	327.0	39.4	66.6	195.5	13.4	7.4
IV. Pre.	No. 6	97	32	358	64	30	2	280.5	84.4	174.5	29.1	35.1	98.5	6.6	5.1
Exp.	"	238	...	687	123	61	...	531.0	162.1	335.9	55.7	68.0	189.9	11.6	5.1
V. Pre.	No. 4	126	...	358	64	2	30	268.3	83.9	175.6	20.6	36.5	105.4	7.1	7.7
Exp.	"	246	...	683	123	...	61	517.3	160.1	338.3	38.6	70.6	203.7	13.8	7.9

Nos. 1, 4, 5 and 6		Pounds eaten of								Pounds of digestible nutrients eaten during period					
Name of cow and period numbers	Nature of ration	Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	Hominy feed	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
JERSEY LILY 2nd															
I. Pre.	No. 4	48	46	240	64	...	32	227.7	84.2	137.2	17.7	25.3	84.6	5.7	6.9
Exp.	"	92	81	459	122	...	61	415.7	160.7	260.6	33.7	47.3	161.0	10.9	6.9
II. Pre.	"	48	42	240	63	...	32	212.4	83.2	135.6	17.5	24.8	85.0	5.7	7.0
Exp.	"	92	80	458	121	...	61	403.1	161.8	259.4	33.5	47.2	160.2	10.8	6.9
III. Pre.	"	43	37	240	64	...	32	206.5	83.8	131.0	17.1	23.3	81.5	5.6	6.9
Exp.	"	84	76	456	122	...	61	403.7	162.7	253.7	32.6	45.3	156.3	11.1	7.0
IV Pre.	"	61	21	236	64	...	32	210.2	83.6	133.4	16.9	23.7	82.2	5.8	7.1
Exp.	"	145	...	450	121	...	61	390.4	158.3	251.6	31.1	45.3	156.9	11.2	7.3
V. Pre.	"	81	...	234	67	...	32	202.4	83.1	134.0	16.6	24.5	83.3	5.9	7.3
Exp.	"	161	...	447	123	...	61	393.9	160.1	260.8	32.2	47.7	161.7	11.5	7.3
STAR BRIGHT															
I. Pre.	No. 4	72	67	360	64	...	32	297.8	84.2	175.6	21.1	36.4	105.2	6.6	7.4
Exp.	"	138	130	686	123	...	61	551.0	161.6	337.7	40.6	69.9	203.3	12.9	7.4
II. Pre.	No. 6	72	65	360	64	30	2	280.8	85.4	175.9	28.8	35.4	99.9	5.9	5.3
Exp.	"	138	118	690	123	61	...	524.5	163.6	334.5	54.3	67.2	189.3	11.5	5.2
III. Pre	No. 4	67	62	359	64	2	30	275.5	83.9	171.4	21.3	35.0	102.8	6.6	7.2
Exp.	"	126	116	672	122	...	61	523.2	162.7	323.1	38.9	65.5	193.1	13.2	7.4
IV. Pre.	No. 6	92	18	345	64	30	2	261.2	84.4	164.3	37.8	32.0	93.3	6.3	5.0
Exp.	"	203	...	617	120	60	...	480.6	158.6	305.3	52.4	59.7	173.4	10.6	4.9
V. Pre.	No. 4	112	...	325	63	2	29	247.6	82.2	162.5	19.4	32.9	98.0	6.7	7.5
Exp.	"	205	576	548	121	...	60	453.4	160.1	296.0	34.9	58.6	180.4	12.6	7.7
STEPHANIE															
I. Pre.	No. 5	72	58	353	31	31	31	296.4	82.5	173.9	26.8	35.5	96.7	8.1	5.6
Exp.	"	138	113	684	62	61	61	536.8	162.5	339.2	52.5	68.5	188.7	16.0	5.6
II. Pre.	"	72	48	359	32	32	32	266.3	85.0	172.7	27.0	34.5	96.4	8.2	5.5
Exp.	"	138	88	679	61	61	61	494.1	161.2	327.8	49.8	65.2	182.9	15.7	5.7
III. Pre.	"	62	52	354	32	32	32	262.4	84.7	168.5	26.7	33.1	94.1	8.2	5.5
Exp.	"	121	104	678	62	61	61	513.5	166.2	327.4	51.8	64.3	181.6	15.9	5.4
IV. Pre.	"	94	23	356	32	32	32	270.8	85.4	173.9	26.9	34.9	97.1	8.5	5.6
Exp.	"	220	...	669	58	58	58	504.4	155.4	326.5	48.9	66.6	173.0	15.8	5.6
V. Pre.	"	106	...	262	25	24	24	211.9	65.0	141.4	21.1	29.3	78.9	6.7	5.8
Exp.	"	242	...	656	60	59	59	507.9	159.8	339.6	50.7	69.6	189.4	16.3	5.8
LIZZIE HEXHAM															
I. Pre.	No. 5	72	51	358	32	32	32	284.2	85.2	173.8	27.1	34.9	96.9	8.3	5.6
Exp.	"	138	93	683	62	61	61	519.4	162.5	330.8	51.6	65.9	184.6	15.8	5.6
II. Pre.	No. 1	72	33	360	62	32	2	253.6	84.5	109.3	28.0	32.7	86.6	6.8	4.8
Exp.	"	138	84	688	123	61	...	493.5	162.1	312.8	54.6	65.2	168.9	13.2	4.8
III. Pre.	No. 5	61	49	360	34	32	30	260.2	84.7	167.2	26.5	32.8	93.3	8.0	5.4
Exp.	"	120	103	673	62	61	61	510.6	166.2	325.7	51.7	64.0	180.8	15.9	5.4
SANTA ROSA															
I. Pre.	No. 1	72	61	360	64	32	...	293.6	85.2	170.5	26.5	36.2	91.6	7.0	5.4
Exp.	"	138	110	681	123	61	...	532.6	161.6	322.7	55.3	68.3	173.5	13.4	4.9
II. Pre.	"	72	39	357	64	32	...	258.0	84.5	160.9	28.4	33.4	86.9	6.7	4.8
Exp.	"	138	87	683	121	61	...	493.2	160.3	312.2	54.4	65.4	168.4	13.1	4.8
III. Pre.	"	63	55	358	63	32	...	265.7	83.6	162.5	28.8	34.2	86.7	6.8	4.7
Exp.	"	125	114	680	119	59	...	518.9	159.1	314.6	54.1	67.0	167.7	13.4	4.9
IV. Pre.	"	94	26	346	64	32	...	268.7	83.2	165.4	28.4	35.1	88.8	7.1	4.9
Exp.	"	236	...	678	123	61	...	528.5	163.4	327.1	54.4	70.5	176.6	14.0	5.1
V. Pre.	"	120	...	354	64	32	...	262.2	83.9	169.1	28.2	36.3	91.2	7.2	5.0
Exp.	"	238	...	678	123	61	...	510.9	161.7	328.2	54.5	70.8	177.2	14.0	5.1

Nos. 1 and 5 Name of cow and period numbers	Nature of ration	Pounds eaten of								Pounds of digestible nutrients eaten during period					Nutritive ratio, 1 :
		Hay	Oat hay	Silage	Bran	½ cottonseed meal ½ linseed meal	Hominy feed	Total dry matter in entire ration	Total dry matter in experimental feed	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	
YEMASSEE															
I. Pre.	No. 1	72	48	357	64	32	...	281.4	85.2	164.7	28.7	34.5	88.7	6.8	4.8
Exp.	“	138	102	690	123	61	...	527.8	161.6	320.6	55.5	67.6	172.7	13.4	4.9
II. Pre.	No. 5	72	47	360	34	32	30	265.6	85.0	171.9	26.9	34.4	95.9	8.1	5.5
Exp.	“	138	93	688	62	61	61	501.2	162.1	331.5	51.6	66.1	185.0	15.9	5.6
III. Pre.	No. 1	63	53	358	61	31	2	263.1	82.7	161.4	28.4	33.8	86.5	6.8	4.8
Exp.	“	117	97	664	119	60	...	494.7	160.0	301.5	52.7	63.0	161.2	13.1	4.8
IV. Pre.	No. 5	87	19	325	34	31	29	252.1	83.6	162.3	25.8	31.4	94.7	7.9	5.6
Exp.	“	193	...	601	60	59	59	468.6	159.0	305.6	47.7	59.7	171.8	15.3	5.6
V. Pre.	No. 1	98	...	326	62	31	2	236.7	83.2	153.7	26.6	31.6	83.4	6.9	4.9
Exp.	“	207	...	612	123	61	...	470.1	161.7	302.7	52.3	63.3	163.6	13.3	4.9
JANICE															
I. Pre.	No. 5	48	44	238	32	32	32	226.4	85.2	141.3	24.5	25.4	72.9	7.5	5.0
Exp.	“	92	79	459	62	61	61	415.8	162.5	269.2	46.6	48.0	150.9	14.2	5.0
II. Pre.	“	48	41	240	32	32	32	213.4	85.0	140.3	24.4	25.1	78.7	7.5	5.0
Exp.	“	92	72	458	62	61	61	396.5	162.1	266.2	46.2	47.1	149.4	14.1	4.9
III. Pre.	“	43	38	240	31	31	30	204.7	81.1	133.6	23.4	23.9	74.4	7.2	4.9
Exp.	“	82	73	453	62	61	61	402.2	166.2	262.1	46.1	45.5	146.9	14.1	4.9
IV. Pre.	“	58	18	205	21	21	20	169.4	55.2	108.6	17.0	21.6	60.6	5.3	5.5
Exp.	“	151	...	438	61	60	60	396.2	161.6	262.8	44.6	46.6	148.5	14.2	5.1
V. Pre.	“	77	...	237	32	32	32	202.1	85.5	138.5	23.6	24.5	78.3	7.4	5.1
Exp.	“	147	...	450	61	60	60	384.7	162.5	262.4	44.5	46.4	148.4	14.2	5.1
HAIDEE															
I. Pre.	No. 5	72	60	359	32	32	32	292.4	85.2	177.7	27.6	36.0	98.8	8.4	5.6
Exp.	“	138	114	690	62	61	61	539.1	162.5	340.6	52.6	68.9	194.2	16.2	5.7
II. Pre.	No. 1	72	58	360	62	31	2	274.2	84.5	169.7	29.2	35.9	91.6	7.0	4.9
Exp.	“	138	112	688	123	61	...	517.5	162.1	324.5	56.0	68.7	174.5	13.5	4.9
III. Pre.	No. 5	66	61	358	34	32	30	274.5	84.7	174.0	27.4	34.9	96.2	8.2	5.5
Exp.	“	125	112	682	60	60	59	520.1	161.6	330.0	51.6	66.1	182.6	15.8	5.5

V. RECORD SHOWING PRODUCTION AND SAME PER UNIT FOR EACH INDIVIDUAL COW IN FEEDING TESTS

Very low and medium feeding Name of cow and period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
Stella No. 6		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
II.	V.low	218.3	21.4	278.8	13.70	4.35	38.20	12.12	127.7	17.5	5.55	.....	....	.....
	"	405.8	40.0	485.0	13.32	4.08	64.61	19.77	119.6	15.9	4.87	.....	....	.....
III.	Med.	274.8	79.5	253.2	13.92	4.48	35.24	11.35	92.1	12.8	4.13	.....	....	...
	"	540.9	164.7	512.0	14.10	4.46	72.22	22.83	94.7	13.4	4.22	.....	....	.....
IV.	V. low	220.2	20.2	218.2	14.09	4.55	30.75	9.93	99.1	14.0	4.51	.....	....	.....
	"	411.9	40.5	396.5	14.40	4.87	57.11	19.30	96.3	13.9	4.69	.....	....	.....
V.	Med.	272.1	83.9	221.7	14.21	4.80	31.50	10.64	81.5	11.6	3.91	.....	....	.....
	"	525.1	161.7	435.6	13.80	4.47	60.11	19.46	82.9	11.4	3.71	.....	....	.....
Eunice No. 1														
II.	Med.	276.2	84.5	422.8	13.64	4.40	57.66	18.60	153.1	20.9	6.73	500.1	68.2	22.01
	"	519.5	160.3	769.4	13.21	3.91	101.62	30.18	148.2	19.6	5.81	480.0	63.4	18.83
III.	Med.	275.8	82.7	369.0	13.73	4.27	50.67	15.77	133.8	18.4	5.72	446.2	61.3	19.07
	"	536.7	163.6	672.7	13.44	4.06	90.40	27.28	126.2	16.8	5.08	411.2	55.3	16.67
IV.	Med.	281.5	83.2	306.9	13.80	4.42	42.35	13.56	109.0	15.0	4.82	368.9	50.9	16.30
	"	533.5	163.4	575.0	14.17	4.66	81.47	26.78	107.8	15.3	5.02	351.9	49.9	16.39
V.	Med.	271.3	83.9	272.8	13.69	4.32	37.35	11.79	100.5	13.8	4.35	325.1	44.5	14.05
	"	524.6	161.7	521.2	13.62	4.21	70.96	21.94	99.4	13.5	4.18	322.3	43.9	13.57
Constance No. 1														
I.	V. low	225.8	21.3	180.1	14.80	5.29	26.65	9.53	79.8	11.8	4.22	845.6	125.1	44.75
	"	414.5	40.4	296.7	15.39	5.88	45.67	17.45	71.6	11.0	4.21	734.6	113.1	43.20
II.	V. low	206.1	21.1	147.1	15.18	5.67	22.33	8.34	71.4	10.8	4.05	697.1	105.8	39.53
	"	386.1	40.5	266.8	14.97	5.49	39.93	14.65	69.1	10.3	3.80	658.8	98.6	36.18
III.	V. low	211.3	21.1	136.2	14.86	5.40	20.24	7.35	64.5	9.6	3.48	645.5	95.9	34.83
	"	409.1	41.1	269.8	14.63	5.16	39.48	13.91	65.9	9.7	3.40	656.4	96.1	33.85
IV.	V. low	220.4	20.8	125.5	15.51	5.69	19.47	7.01	56.9	8.8	3.18	603.4	93.6	33.70
	"	406.7	40.8	204.5	15.83	5.85	32.38	11.97	50.3	8.0	2.94	501.2	79.4	29.34
V.	V. low	214.1	21.0	79.5	15.76	5.79	12.53	4.60	37.1	5.9	2.15	378.6	59.7	21.90
	"	384.3	37.8	127.8	15.77	5.98	20.15	7.64	33.3	5.2	1.99	338.1	53.3	20.21
Beautina														
I.	V. low	235.8	21.3	171.3	14.27	4.86	24.44	8.32	72.6	10.4	3.53	.....	.....	.....
	"	434.2	40.4	297.6	14.60	5.17	43.47	15.28	68.5	10.0	3.52	.....	.....	.....
II.	Med.	277.9	79.9	172.8	14.69	5.16	25.38	8.92	62.18	9.1	3.21	.....	.....	.....
	"	533,9	162.1	332,9	14.03	4.67	46.71	15.54	82.3	8.5	2.91	.....	.....	.....
III.	V. low	220.6	21.1	150.0	14.08	4.70	21.12	7.05	68.0	9.6	3.20	.....	.....	.....
	"	433.7	41.1	275.4	13.96	4.67	38.44	12.85	63.5	8.9	2.96	.....	.....	.....
IV.	Med.	275.5	78.0	150.2	14.48	5.12	21.75	7.69	54.5	7.9	2.79	.....	.....	.....
	"	533.5	163.4	290.1	14.57	5.16	42.27	14.97	54.4	7.9	2.81	.....	.....	.....
Lady Perusia														
IV.	V.low	493.3	41.2	673.5	14.54	5.16	97.95	34.72	136.5	19.9	7.04	1634.8	237.8	84.28
	"	261.9	21.1	311.7	14.52	5.17	45.27	16.13	119.0	17.3	6.16	1477.2	214.5	76.45
	"	503.4	40.5	552.8	14.42	5.16	79.72	28.50	109.8	15.8	5.66	1365.0	196.9	70.38
V.	"	253.8	21.0	273.2	14.24	5.10	38.91	13.92	107.6	15.3	5.49	1301.0	185.3	66.29
	"	487.1	40.4	539.8	14.14	5.02	76.31	27.10	110.8	15.7	5.56	1336.2	188.9	67.08

* In total ration. † In experimental portion of ration.

Very low, low and medium feeding Name of cow and period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
SERENA														
No. 6		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
III. V.l.		478.9	39.4	678.6	13.24	4.07	89.87	27.63	141.7	18.8	5.77	......	.....	.....
IV. Med.		305.2	79.2	323.4	13.27	3.95	42.91	12.77	106.0	14.1	4.18	......	.....	.....
"		598.8	159.5	550.6	14.08	4.68	77.52	25.74	92.0	12.9	4.30	......	.....	.....
V. V.l.		249.3	21.0	224.6	13.58	4.35	30.50	9.77	90.1	12.2	3.92	......	.....	.....
"		494.2	40.4	454.3	13.40	4.27	60.88	19.42	91.9	12.3	3.93	......	.....	.....
MINTA BELLA														
No. 1														
I. Med.		295.9	85.2	181.6	16.23	6.32	29.48	11.48	61.4	10.0	3.88	213.2	34.6	13.48
"		542.9	159.8	340.9	16.17	6.30	55.12	21.48	62.8	10.2	3.95	213.3	34.5	13.44
II. Med.		274.1	83.6	176.0	16.02	6.23	28.20	10.96	64.2	10.3	3.99	210.5	33.7	13.11
"		510.8	162.1	312.1	16.04	6.37	50.06	19.88	61.1	9.8	3.89	192.5	30.9	12.26
III. Med.		271.8	81.8	163.3	15.82	6.29	25.84	10.27	60.1	9.5	3.78	199.7	31.6	12.56
"		523.9	162.7	317.5	16.16	6.45	51.31	20.47	60.6	9.8	3.91	195.2	31.5	12.58
JUDITH														
No. 1														
I. Med.		263.2	85.2	190.6	16.21	6.21	30.89	11.83	72.4	11.7	4.49	......	.....	.....
"		486.0	158.9	349.8	16.79	6.70	58.72	23.44	72.0	12.1	4.82	......	.....	.....
II. V.low		194.3	21.1	155.1	16.50	6.30	25.59	9.77	79.8	13.2	5.03	......	.....	.....
"		350.5	39.6	219.9	16.49	6.15	36.26	13.52	62.7	10.3	3.86	......	.....	.....
III. Med.		228.9	77.4	98.4	17.14	6.50	16.87	6.40	43.0	7.4	2.80	......	.....	.....
"		480.8	164.5	182.4	16.90	6.25	30.82	11.41	37.9	6.4	2.37	......	.....	.....
LUCERNE														
No. 6														
II. "		263.7	20.5	239.4	14.08	4.73	33.70	11.31	90.8	12.8	4.29	1167.8	164.4	55.18
"		484.6	40.9	413.6	14.29	4.75	59.11	19.65	85.4	12.2	4.06	1011.3	144.5	48.05
III. "		258.9	21.2	189.6	14.45	4.96	27.39	9.40	73.2	10.6	3.63	894.4	129.2	44.35
"		498.5	41.2	360.2	14.83	5.17	53.43	18.62	72.3	10.7	3.74	874.2	129.7	45.20
IV. "		254.1	21.1	183.2	14.39	4.97	26.37	9.11	72.1	10.4	3.59	868.2	125.0	43.18
"		478.3	40.5	338.1	14.95	5.25	50.55	17.71	70.7	10.6	3.71	834.8	124.8	43.83
V. "		253.9	21.0	187.4	14.93	5.33	27.97	9.98	73.8	11.0	3.93	892.4	133.2	47.53
"		471.0	40.4	362.2	14.43	5.04	52.23	18.27	76.9	11.1	3.88	896.6	129.3	45.22
YUBA														
No. 6														
II. Low		260.5	42.5	250.6	14.00	4.64	35.08	11.62	96.2	13.5	4.46	......	.....	.....
"		522.6	81.8	455.6	13.89	4.54	63.22	20.71	87.2	12.1	3.96	......	.....	.....
III. V.low		250.8	21.2	211.4	14.14	4.75	29.89	10.03	84.3	11.9	4.00	......	.....	.....
"		485.5	41.2	399.1	14.37	4.94	57.34	19.70	82.2	11.8	4.06	......	.....	.....
IV. Low		275.1	42.2	206.9	14.37	5.00	29.73	10.34	75.2	10.8	3.76	......	.....	.....
"		538.0	79.3	392.7	14.42	4.93	56.65	19.37	73.0	10.5	3.60	......	.....	.....
V. V.low		253.5	21.0	194.4	14.42	5.05	28.03	9.82	76.7	11.1	3.87	......	.....	.....
"		487.9	39.6	379.2	14.36	5.01	54.46	18.98	77.7	11.2	3.89	......	.....	.....

* In total ration. † In experimental portion of ration.

Very low and medium feeding Name of cow and period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
LAVENDER														
No. 1		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I.	Low	298.3	42.6	213.4	14.54	5.07	31.03	10.81	71.5	10.4	3.62	501.0	72.8	25.38
	“	548.5	80.8	343.9	14.99	5.56	51.54	19.11	62.7	9.4	3.48	425.6	63.8	23.65
II.	“	284.5	42.2	175.2	15.15	5.52	26.54	9.67	61.6	9.3	3.40	415.2	63.0	22.92
	“	516.5	81.1	293.2	15.00	5.65	43.98	16.57	56.8	8.5	3.21	361.5	54.2	20.43
III.	“	274.8	42.2	153.5	15.06	5.55	23.11	8.52	55.9	8.4	3.10	363.8	54.8	20.19
	“	537.4	82.2	323.5	14.86	5.58	48.38	18.06	60.2	9.0	3.36	393.5	58.9	21.97
IV.	“	268.6	41.6	161.2	15.16	5.70	24.44	9.19	60.0	9.1	3.42	387.5	58.8	22.09
	“	534.1	81.7	292.4	15.36	5.81	44.91	16.99	54.7	8.4	3.18	359.9	55.0	20.80
V.	“	274.6	42.0	160.5	15.13	5.62	24.28	9.02	58.5	8.8	3.29	382.2	57.8	21.48
	“	511.7	80.9	279.6	15.37	5.72	42.98	16.00	54.6	8.4	3.13	345.6	53.1	19.78
URSULA														
No. 1														
I.	Low	299.2	42.6	243.8	14.87	5.25	36.26	12.81	81.5	12.1	4.28	......	......	.....
	“	549.4	79.9	418.1	14.92	5.40	62.38	22.58	76.1	11.4	4.11	......	......	.....
II.	V.low	263.4	21.1	201.6	14.83	5.27	29.89	10.63	76 5	11.4	4.04	......	......	.....
	“	463.2	40.5	365.4	14.69	5.18	53.64	18.92	78.9	11.6	4.08	......	......	.....
III.	Low	264.4	42.2	173.7	14.70	5.22	25.54	9.07	65.7	9.7	3.43	......	......	.....
	“	530.7	82.2	353.4	14.60	5.23	51.60	18.49	66.6	9.7	3.48	......	......	.....
IV.	V.low	243.5	20.8	172.0	14.70	5.30	25.29	9.11	70.6	10.4	3.74	......	......	.....
	“	473.2	40.8	310.8	14.91	5.45	46.34	16.94	65.7	9.8	3.58	......	......	.....
V.	Low	258.8	42.0	174.6	14.75	5.35	25.75	9.34	67.5	9.9	3.61	......	......	.....
	“	499.0	80.9	338.6	14.33	5.10	48.50	17.28	67.9	9.7	3.46	......	......	.....
ELSA														
No. 6														
II.	“	233.4	42.7	154.2	15.36	5.70	23.68	8.79	66.1	10.2	3.77	361.2	55.5	20.59
	“	438.2	80.9	277.2	15.01	5.43	41.60	15.05	63.3	9.5	3.44	342.7	51.4	18.60
III.	“	230.0	42.4	130.5	15.56	5.85	20.31	7.64	56.7	8.8	3.33	307.8	47.9	18.02
	“	441.1	80.5	252.9	15.24	5.60	38.54	14.16	57.3	8.7	3.21	314.2	47.9	17.59
IV.	“	233.5	42.2	129.8	14.94	5.45	19.39	7.07	55 6	8.3	3.03	307.6	45.9	16.75
	“	437.6	79.3	241.3	15.28	5.69	36.86	13.72	55.1	8.4	3.14	304.3	46.5	17.30
V.	“	206.9	39.3	122.6	15.30	5.79	18.76	7.10	59.3	9.1	3.43	312.0	47.7	18.08
	“	420.3	80.9	239.4	14.97	5.54	35.83	13.25	57.0	8.5	3.15	295.9	44.3	16.38
VIVIAN														
No. 6														
II.	V.low	210.3	21.4	178.0	13.87	4.43	24.69	7.88	84.6	11.7	3.75	......	......	.....
	“	390.4	40.0	332.7	13.41	4.19	44.60	13.93	85.2	11.4	3.57	......	......	.....
III.	Low	222.1	42.4	179.5	13.62	4.30	24.44	7.71	80.8	11.0	3.47	......	......	.....
	“	415.6	81.4	356.0	13.80	4.43	49.12	15.78	85.7	11.8	3.80	......	......	.....
IV.	V.low	203.9	21.1	178.3	13.54	4.22	24.15	7.53	87.4	11.8	3.69	......	......	.....
	“	374.0	40.5	329.9	14.05	4.63	46.35	15.27	88.2	12.4	4.08	......	......	.....
V.	Low	216.0	42.0	183.2	13.96	4.55	25.56	8.34	84.8	11.8	3.86	......	......	.....
	“	420.7	80.9	358.5	13.78	4.53	49.41	16.24	85.2	11.7	3.86	......	......	.....

* In total ration. † In experimental portion of ration.

Nos. 7 and 1, pulp

Name of cow and period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
ACME														
		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I	No. 7	308.1	105.9	409.4	11.81	3.52	48.35	14.43	132.9	15.7	4.68	386.6	45.6	13.63
	"	588.8	206.8	747.5	12.03	3.53	89.90	26.41	127.0	15.3	4.48	361.5	43.4	12.77
II.	"	294.2	107.8	384.4	11.83	3.40	45.47	13.07	130.7	15.5	4.43	356.6	42.1	12.15
	"	528.1	207.0	703.1	11.51	3.20	80.90	22.47	133.1	15.3	4.25	339-7	39.1	10.86
III.	"	259.5	107.9	326.2	11.58	3.53	37.79	11.50	125.7	14.6	4.43	302.3	35.0	10.66
	"	483.8	202.5	550.4	11.15	3.26	61.36	17.93	113.8	12.7	3.71	271.8	30.3	8.85
IV.	"	232.1	106.0	246.8	11.12	3.45	27.44	8.52	106.3	11.8	3.67	232.8	25.9	8.05
	"	408.1	196.0	402.4	11.28	3.68	45.41	14.79	98.6	11.1	3.62	205.3	23.2	7.55
V.	"	192.4	98.8	181.5	10.98	3.50	19.92	6.35	94.3	10.4	3.30	183.7	20.2	6.43
	"	428.8	200.9	404.1	10.93	3.41	44.06	13.76	94.2	10.3	3.21	201.1	22.0	6.85
ATALANTA														
I.	No. 7	314.3	105.9	402.4	12.74	3.75	51.21	15.09	128.1	16.3	4.80	380.0	48.4	14.25
	"	590.8	206.8	724.2	12.52	3.58	90.63	25.94	122.6	15.3	4.39	350.2	43.8	12.55
II.	No. 1	295.5	105.8	349.6	12.46	3.70	43.58	12.95	118.3	14.8	4.38	330.4	41.2	12.24
	"	556.7	202.6	607.3	12.05	3.44	73.14	20.91	109.1	13.1	3.76	299.7	36.1	10.32
III.	No. 7	291.0	107.9	287.5	12.07	3.48	34.69	9.99	98.8	11.9	3.43	266.5	32.1	9.26
	"	564.7	208.8	523.7	11.91	3.38	62.35	17.70	92.7	11.0	3.13	250.8	29.9	8.48
IV.	No. 1	273.1	86.3	242.8	12.23	3.66	29.69	8.99	88.9	10.9	3.29	281.4	34.4	10.42
	"	554.1	204.2	416.4	12.08	3.71	50.32	15.47	75.1	9.1	2.79	203.9	24.6	7.58
V.	No. 7	274.4	105.8	193.9	12.00	3.80	23.26	7.36	70.7	8.5	2.68	183.3	22.0	6.96
	"	546.2	205.4	430.3	12.44	3.75	53.52	16.14	78.8	9.8	2.96	209.5	26.1	7.86
ELIZABETH														
I.	No. 1	226.0	85.2	245.8	15.50	5.55	38.10	13.64	108.8	16.9	6.03	288.5	44.7	16.01
	"	422.9	161.6	406.2	15.87	5.94	64.46	24.12	96.0	15.2	5.70	251.4	39.9	14.93
II.	"	212.9	84.5	198.7	15.91	5.95	31.61	11.82	93.1	14.9	5.55	235.4	37.4	13.99
	"	402.7	158.6	331.5	15.94	6.11	52.84	20.24	82.3	13.1	5.03	209.0	33.3	12.76
III.	"	216.4	84.5	169.4	16.15	6.25	27.36	10.58	78.3	12.6	4.89	200.5	32.4	12.52
	"	419.2	164.5	321.3	15.77	5.88	50.65	18.90	76.6	12.1	4.51	195.3	30.8	11.49
IV.	"	219.5	83.2	155.8	16.35	6.36	25.47	9.91	71.0	11.6	4.51	187.3	30.6	11.91
	"	418.9	163.4	275.4	16.30	6.46	44.89	17.78	65.7	10.7	4.24	168.5	27.5	10.88
V.	"	205.2	83.9	137.1	16.38	6.57	22.46	9.01	66.8	10.9	4.39	163.4	26.8	10.74
	"	409.5	161.7	265.8	16.06	6.40	42.69	17.00	64.9	10.4	4.15	164.4	26.4	10.51
SANTA CLARA														
I.	No. 1	254.2	85.2	224.1	16.01	5.96	35.88	13.35	88.2	14.1	5.25	263.0	42.1	15.67
	"	469.4	161.6	398.7	16.29	6.29	64.94	25.08	84.9	13.8	5.34	246.7	40.2	15.52
II.	No. 7	238.7	86.2	206.1	16.47	6.45	33.95	13.30	86.3	14.2	5.57	239.1	39.4	15.43
	"	448.0	165.6	390.0	16.09	6.21	62.76	24.22	87.1	14.0	5.41	235.5	37.9	14.62
III.	No. 1	238.6	84.6	183.8	16.27	6.37	29.91	11.71	77.0	12.5	4.91	217.3	35.4	13.84
	"	452.0	164.5	366.3	16.33	6.38	59.81	23.36	81.0	13.2	5.17	222.7	36.4	14.20
IV.	No. 7	230.4	84.2	192.2	16.57	6.40	31.85	12.30	83.4	13.8	5.34	228.3	37.8	14.61
	"	435.2	160.8	368.6	16.68	6.55	61.48	24.16	84.7	14.1	5.55	229.2	38.2	15.03
V.	No. 1	222.8	84.1	186.8	16.17	6.30	30.20	11.77	83.9	13.6	5.29	222.1	35.9	14.00
	"	432.1	161.7	363.9	15.86	6.16	57.72	22.43	84.2	13.4	5.19	225.0	35.7	13.87
MONA														
II.	No. 1	508.0	162.1	625.1	14.37	5.05	89.80	31.56	123.1	17.7	6.21	385.7	55.4	19.47
III.	No. 7	260.2	80.9	284.4	14.13	4.88	40.19	13.87	109.3	15.4	5.34	351.5	49.7	17.15
	"	529.8	167.1	579.6	14.40	4.85	83.45	28.09	109.4	15.8	5.30	346.9	49.9	16.81
IV.	No. 1	275.2	83.4	301.9	14.30	4.90	43.17	14.79	109.7	15.7	5.37	362.0	51.8	17.73
	"	519.9	163.4	543.4	14.51	5.10	78.82	27.72	104.5	15.2	5.33	332.5	48.4	16.96
V.	No. 7	261.2	84.3	279.9	14.40	5.00	40.30	13.99	107.2	15.4	5.36	332.0	47.8	16.60
	"	527.6	164.3	554.1	14.04	4.80	77.79	26.60	105.0	14.7	5.04	337.2	47.3	16.19

* In total ration. † In experimental portion of ration.

Nos. 1 and 7, pulp and silage Name of cow and period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
ORPHA														
		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I.	No. 7	276.8	87.6	148.6	13.48	4.14	20.03	6.15	53.7	7.2	2.22	169.6	22.9	7.02
	"	546.3	165.4	250.9	13.80	4.42	34.63	11.09	46.1	6.3	2.03	151.7	20.9	6.70
II.	No. 7	279.2	86.2	118.0	13.56	4.50	15.95	5.31	42.3	5.7	1.90	136.9	18.5	6.16
	"	507.7	165.6	208.8	13.23	4.32	27.62	9.01	41.1	5.4	1.77	126.1	16.7	5.44
III.	No. 7	259.2	86.3	96.3	13.14	4.20	12.64	4.04	37.2	4.9	1.56	111.6	14.6	4.68
	"	517.9	164.3	186.5	13.47	4.27	25.12	7.96	36.0	4.9	1.54	113.5	15.3	4.84
ALTA														
I.	Pulp	251.4	‡22.5	201.7	14.83	5.26	29.92	10.62	80.2	11.9	4.22	.....	.....	.....
	"	559.4	183.8	422.9	15.06	5.35	63.70	22.61	75.6	11.4	4.04	230.1	34.7	12.30
II.	Pulp	294.4	92.9	220.1	15.43	5.60	33.96	12.33	74.8	11.5	4.19	236.9	36.5	13.27
	"	538.0	181.0	396.8	15.30	5.47	60.70	21.71	73.8	11.3	4.04	219.2	33.5	11.99
III.	Pulp	290.9	104.2	208.7	15.75	5.85	32.87	12.21	71.8	11.3	4.20	200.3	31.5	11.72
	"	559.7	184.6	404.6	15.73	5.71	63.64	23.10	72.3	11.4	4.13	219.2	34.5	12.51
IV.	Pulp	270.5	99.2	209.9	16.46	6.07	34.55	12.74	77.6	12.8	4.71	211.6	34.8	12.84
	"	511.4	185.2	380.4	16.43	6.12	62.51	23.27	74.4	12.2	4.55	205.4	33.8	12.56
V.	Pulp	267.5	94.7	197.2	16.23	6.10	32.01	12.02	73.7	12.0	4.49	208.2	33.8	12.69
	"	501.6	194.9	354.9	15.61	5.83	55.40	20.69	70.8	11.0	4.13	182.1	28.4	10.61
ADELAIDE														
I.	Pulp	257.7	‡22.5	157.7	15.85	6.09	24.99	9.60	61.2	9.7	3.72	.....	.....	.....
	"	597.6	205.3	346.7	15.43	5.66	53.48	19.61	58.0	9.0	3.28	168.9	26.0	9.55
II.	Silage	290.2	83.5	165.8	15.37	5.60	25.48	9.28	57.1	8.8	3.20	198.6	30.5	11.15
	"	501.2	140.6	296.2	15.13	5.52	44.81	16.36	59.1	8.9	3.26	210.7	31.9	11.64
III.	Pulp	302.7	109.9	161.1	15.44	5.69	24.88	9.17	53.2	8.2	3.03	146.6	22.6	8.34
	"	577.5	203.3	339.8	14.90	5.32	50.61	18.07	58.8	8.8	3.13	167.1	24.9	8.89
IV.	Silage	279.5	103.0	158.9	14.78	5.40	23.49	8.58	56.8	8.4	3.07	154.3	22.8	8.33
	"	496.5	157.9	273.4	15.45	5.84	42.24	15.97	55.1	8.5	3.22	173.1	26.8	10.11
V.	Pulp	283.4	95.5	161.9	15.39	5.72	24.92	9.26	57.1	8.8	3.27	169.5	26.1	9.70
	"	556.0	204.0	347.8	15.05	5.48	52.33	19.05	62.6	9.4	3.43	170.5	25.7	9.34
NANCY B.														
I.	Silage	287.7	92.2	238.1	12.34	3.60	29.39	8.57	82.8	10.2	2.98	258.3	31.9	9.29
	"	546.6	160.1	448.1	12.59	3.71	56.44	16.61	82.0	10.3	3.04	279.9	35.2	10.38
II.	Pulp	290.8	109.3	245.2	13.00	4.09	31.87	10.04	84.3	11.0	3.45	224.3	29.2	9.19
	"	568.0	214.6	457.5	12.47	3.63	57.03	16.59	80.5	10.0	2.92	213.2	26.6	7.73
III.	Silage	273.4	81.0	231.2	12.18	3.60	28.15	8.33	84.6	10.3	3.05	285.5	34.8	10.28
	"	512.7	156.2	420.9	12.26	3.56	51.60	14.99	82.1	10.1	2.92	269.5	33.0	9.60
IV.	Pulp	305.5	111.7	218.6	12.32	3.57	26.94	7.81	71.6	8.8	2.56	195.6	24.1	6.99
	"	554.1	213.0	410.8	12.67	3.99	52.02	16.37	74.2	9.4	2.95	192.9	24.4	7.69
V.	Silage	261.5	77.7	199.1	12.73	3.97	25.33	7.91	76.1	9.7	3.03	256.3	32.6	10.18
	"	467.8	131.3	372.5	12.71	4.04	47.34	15.04	79.6	10.1	3.22	283.7	36.1	11.45
UNA														
I.	Pulp	253.8	74.9	172.3	15.84	6.06	27.29	10.44	67.9	10.8	4.13	230.0	36.4	13.94
	"	522.1	214.6	351.6	15.46	5.80	54.37	20.38	67.3	10.4	3.91	163.8	25.3	9.50
II.	Silage	215.4	84.5	144.4	15.92	6.29	22.99	9.09	67.0	10.7	4.22	170.9	27.2	10.76
	"	410.4	93.6	261.3	15.73	6.16	41.11	16.09	63.7	10.0	3.92	279.2	43.9	17.19
III.	Pulp	267.5	111.7	145.3	15.84	6.08	23.01	8.83	54.4	8.6	3.30	130.1	20.6	7.90
	"	510.3	211.8	304.2	15.36	5.74	46.73	17.47	59.6	9.2	3.42	143.6	22.1	8.25
IV.	Silage	224.4	60.9	138.5	15.57	6.02	21.57	8.34	61.7	9.6	3.72	227.4	35.4	13.70
	"	417.1	108.1	236.7	16.39	6.69	38.79	15.84	56.7	9.3	3.80	219.0	35.9	14.65
V.	Pulp	249.8	105.2	155.2	15.87	6.29	24.63	9.77	62.1	9.9	3.91	147.5	23.4	9.29
	"	504.2	199.5	327.3	15.25	5.80	49.91	18.97	64.9	9.9	3.76	164.1	25.0	9.51

* In total ration. † In experimental portion of ration. ‡ Pulp late in arriving and cows slow in eating it at first.

Pulp, Nos. 3 and 1

Name of cow and period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
SURPRISE														
		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I.	Pulp	250.2	73.0	188.7	15.79	5.59	29.79	10.55	75.4	11.9	4.22	258.5	40.8	14.45
	“	510.0	214.6	359.8	15.89	5.81	57.17	20.93	70.5	11.2	4.10	167.7	26.6	9.75
II.	“	258.6	106.6	171.7	16.37	6.18	28.10	10.62	66.4	10.9	4.11	161.0	26.3	9.96
	“	501.9	209.9	334.0	15.97	5.85	53.34	19.54	66.5	10.6	3.89	159.1	25.4	9.31
III.	“	266.0	113.6	178.3	16.34	6.12	29.14	10.92	67.0	11.0	4.11	157.0	25.7	9.61
	“	505.0	209.0	354.5	16.26	6.06	57.64	21.48	70.2	11.4	4.25	169.6	27.6	10.28
IV.	“	262.1	110.6	182.1	16.24	6.00	29.57	10.93	69.5	11.3	4.17	164.6	26.7	9.88
	“	422.9	167.6	293.7	17.32	7.04	50.88	20.68	69.4	12.0	4.89	175.2	30.4	12.34
V.	“	245.3	92.0	175.5	16.33	6.12	28.67	10.74	71.6	11.7	4.38	190.8	31.2	11.67
	“	491.7	192.2	366.3	15.90	5.92	58.21	21.70	74.5	11.8	4.41	190.6	30.3	11.29
SONOMA														
II.	No. 3													
	“	506.5	158.6	665.3	14.09	4.48	93.76	29.82	131.4	18.5	5.89	419.0	59.1	18.80
III.	No. 3	270.3	82.2	338.9	14.44	4.60	48.93	15.59	125.4	18.1	5.77	412.3	59.5	18.97
	“	527.7	163.0	655.3	13.95	4.50	91.42	29.48	124.2	17.3	5.59	402.0	56.1	18.08
IV.	“	273.3	83.6	324.7	14.20	4.67	46.11	15.17	118.8	16.9	5.55	388.4	55.1	18.15
	“	538.1	161.0	592.3	14.51	5.03	85.91	29.81	110.1	16.0	5.54	367.9	53.4	18.52
V.	“	266.8	83.7	300.1	14.33	4.90	43.00	14.71	112.5	16.1	5.51	358.5	51.4	17.57
	“	515.6	160.3	576.9	14.19	4.81	81.86	27.76	111.9	15.9	5.38	359.9	51.1	17.32
CERES														
II.	No. 3													
	“	525.8	162.1	733.2	13.33	4.20	97.76	30.82	139.5	18.6	5.86	452.3	60.3	19.02
III.	No. 1	281.8	82.3	363.0	13.74	4.60	49.87	16.69	128.8	17.7	5.92	441.0	60.6	20.28
	“	540.4	163.0	669.7	13.86	4.61	92.79	30.84	123.9	17.2	5.71	410.9	56.9	18.92
IV.	No. 3	292.8	83.3	319.7	14.37	4.90	45.95	15.67	109.2	15.7	5.35	383.8	55.2	18.81
	“	528.0	159.8	597.4	14.33	4.99	85.59	29.83	113.2	16.2	5.65	373.9	53.6	18.67
V.	No. 1	276.4	83.8	312.2	14.17	4.95	44.22	15.44	113.0	16.0	5.59	372.5	52.8	18.42
	“	531.7	161.2	605.3	13.86	4.79	83.92	28.99	113.8	15.8	5.43	375.5	52.1	17.99
MAID MARIAN														
II.	No. 1	271.5	81.0	429.2	13.29	3.91	57.05	16.79	158.1	21.0	6.18	529.9	70.4	20.73
	“	522.1	159.5	776.7	13.08	4.02	101.60	31.24	148.8	19.5	5.98	487.0	63.7	19.59
III.	“	280.6	84.5	382.8	13.29	4.32	50.89	16.55	136.4	18.1	5.90	453.0	60.2	19.59
	“	536.8	164.5	697.3	13.43	4.35	93.66	30.35	129.9	17.4	5.65	424.0	56.9	18.45
IV.	“	278.7	83.2	318.5	13.65	4.51	43.47	14.35	114.3	15.6	5.15	382.8	52.2	17.25
	“	541.5	163.4	575.0	14.09	4.89	80.99	28.14	106.2	15.0	5.20	351.9	49.6	17.22
V.	“	268.5	83.9	291.2	13.77	4.65	40.11	13.55	108.5	14.9	5.05	347.1	47.8	16.15
	“	524.8	161.7	575.1	13.57	4.62	78.03	26.56	109.6	14.9	5.06	355.7	48.3	16.43
ROSEMARY														
II.	No. 3													
	“	510.1	158.6	617.4	13.35	3.93	82.40	24.27	121.0	16.1	4.76	389.3	51.7	15.30
III.	No. 1	275.3	84.3	286.5	13.51	4.33	38.71	12.40	104.1	14.1	4.50	339.8	45.9	14.71
	“	539.2	164.5	538.2	13.38	4.19	71.98	22.57	99.8	13.3	4.19	327.2	43.8	13.72
IV.	No. 3	277.7	82.0	278.2	13.71	4.40	38.12	12.25	100.2	13.7	4.41	339.3	46.5	14.93
	“	532.9	161.0	473.3	13.89	4.65	65.77	22.01	88.8	12.3	4.13	294.0	40.9	13.68
V.	No. 1	271.4	83.9	237.8	13.92	4.70	33.10	11.18	87.6	12.2	4.12	283.5	39.5	13.33
	“	514.2	161.7	446.3	13.67	4.61	61.09	20.56	86.8	11.9	4.00	276.0	37.8	12.72

* In total ration. † In experimental portion of ration.

										Weight of products obtained per 100 lbs. of dry matter eaten					
										In entire ration			In experimental feed		
Nos. 1, 2 and 3	Name of cow and period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Milk	Total solids	Fat	Milk	Total solids	Fat
	MAX BELLE		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I.		No. 3	270.9	83.5	100.8	15.95	5.90	16.08	5.95	37.2	5.9	2.20	120.7	19.3	7.13
		"	536.5	158.6	177.9	16.81	6.46	29.91	11.49	33.2	5.6	2.14	112.2	18.9	7.25
II.		"	271.9	83.2	103.2	16.65	6.30	17.18	6.50	38.0	6.3	2.39	124.0	20.6	7.81
		"	481.5	158.6	157.7	16.94	6.75	26.72	10.65	32.7	5.6	2.21	99.4	16.8	6.71
III.		"	254.3	81.3	81.4	16.88	6.54	13.74	5.32	32.0	5.4	2.09	100.1	16.9	6.54
		"	515.0	160.4	159.8	16.93	6.53	27.05	10.44	31.0	5.3	2.03	99.6	16.9	6.51
IV.		"	267.9	83.6	80.5	16.80	6.45	13.52	5.19	30.1	5.1	1.94	96.3	16.2	6.21
		"	475.9	161.0	138.4	17.38	6.89	24.06	9.54	29.1	5.1	2.00	86.0	14.9	5.93
V.		"	241.0	83.7	70.9	17.18	6.85	12.18	4.86	29.4	5.1	2.02	84.7	14.6	5.81
		"	459.3	155.9	161.3	16.34	6.34	26.33	10.23	35.1	5.7	2.23	103.5	16.9	6.56
	MURIEL														
I.		No. 3	184.1	60.9	89.7	16.27	6.30	14.59	5.65	48.7	7.9	3.07	147.3	24.0	9.28
		"	361.3	118.1	158.5	16.75	6.66	26.55	10.56	44.0	7.4	2.92	134.2	22.5	8.94
II.		No. 1	203.8	84.4	76.8	17.23	7.10	13.23	5.45	37.7	6.5	2.67	91.0	15.7	6.46
		"	336.2	115.4	148.2	16.58	6.69	24.57	9.92	44.1	7.3	2.95	128.5	21.3	8.60
III.		No. 3	179.3	61.7	76.1	16.76	6.73	12.75	5.12	42.4	7.1	2.86	123.3	20.7	8.30
		"	336.8	119.6	137.4	16.39	6.55	22.52	9.00	40.8	6.7	2.67	114.9	18.8	7.53
IV.		No. 1	170.9	62.5	67.7	16.87	6.93	11.42	4.69	39.6	6.7	2.74	108.3	18.3	7.50
		"	326.2	122.5	122.9	17.02	7.14	20.92	8.77	37.7	6.4	2.69	100.3	17.1	7.16
V.		No. 3	173.7	62.8	67.9	16.75	6.94	11.37	4.71	39.1	6.6	2.71	108.1	18.1	7.50
		"	345.3	118.1	147.3	16.14	6.46	23.77	9.51	42.7	6.9	2.75	124.7	20.1	8.05
	EVA														
I.		No. 2	285.8	77.4	182.2	16.87	6.49	30.74	11.83	63.8	10.7	4.14	235.4	39.7	15.28
		"	539.8	157.2	334.7	17.10	6.70	57.23	22.43	62.0	10.6	4.15	212.9	36.4	14.27
II.		"	275.1	82.1	174.7	17.02	6.64	29.73	11.59	63.5	10.8	4.21	212.8	36.2	14.12
		"	497.0	151.3	311.8	16.99	6.75	52.98	21.06	62.7	10.7	4.23	206.1	35.0	13.92
III.		"	269.3	77.3	160.5	17.24	6.87	27.68	11.03	59.6	10.3	4.10	207.6	35.8	14.26
		"	523.4	158.0	323.7	17.12	6.82	55.42	22.07	61.8	10.6	4.22	204.9	35.1	13.97
IV.		"	270.2	80.6	165.8	17.20	6.75	28.51	11.19	61.4	10.6	4.14	205.8	35.4	13.87
		"	516.7	153.8	309.7	17.54	7.10	54.33	22.00	59.9	10.5	4.26	201.4	35.3	14.30
V.		"	260.4	81.6	164.1	17.12	6.90	28.09	11.33	63.0	10.8	4.35	201.1	34.4	13.89
		"	495.5	154.5	331.5	16.50	6.53	54.70	21.63	66.9	11.0	4.37	214.6	35.4	14.00
	MERMAID														
I.		No. 2	290.8	81.8	197.2	16.35	6.10	32.24	12.03	67.8	11.1	4.14	241.1	39.4	14.71
		"	548.9	157.2	351.4	16.63	6.44	58.42	22.62	64.0	10.7	4.12	223.5	37.2	14.39
II.		No. 1	287.3	84.3	172.8	16.88	6.77	29.17	11.70	60.1	10.2	4.07	205.0	34.6	13.88
		"	531.9	162.1	323.6	16.72	6.65	54.09	21.51	60.8	10.2	4.07	199.6	33.4	13.27
III.		No. 2	278.8	81.8	154.0	16.86	6.71	25.96	10.33	55.2	9.3	3.71	188.3	31.8	12.63
		"	539.6	160.6	311.1	17.01	6.72	52.91	20.91	57.7	9.8	3.88	193.7	32.9	13.02
IV.		No. 1	282.3	83.0	158.4	17.11	6.79	27.10	10.76	56.1	9.6	3.81	190.9	32.7	12.96
		"	534.7	163.4	292.6	17.40	6.98	50.92	20.42	54.7	9.5	3.82	179.1	31.2	12.50
V.		No. 2	272.9	81.9	157.6	16.93	6.60	26.68	10.41	57.8	9.8	3.81	192.4	32.8	12.71
		"	514.7	157.9	296.2	16.50	6.52	48.88	19.30	57.6	9.5	3.75	187.6	31.0	12.22
	EDITH														
I.		No. 1	272.3	85.2	173.5	14.95	5.25	25.95	9.11	63.7	9.5	3.35	203.7	30.5	10.69
		"	542.5	161.6	312.3	14.85	5.33	46.37	16.65	57.6	8.6	3.07	193.3	28.6	10.30
II.		"	278.3	84.5	148.5	15.08	5.50	22.40	8.17	53.4	8.1	2.94	175.8	26.5	9.67
		"	515.9	162.1	248.1	14.99	5.34	37.18	13.24	48.1	7.2	2.57	153.0	22.9	8.17
III.		"	226.7	62.5	95.5	15.82	5.99	15.11	5.72	42.1	6.7	2.52	152.8	24.2	9.15
		"	494.1	152.0	135.0	16.10	5.73	21.73	7.74	27.3	4.4	1.57	88.8	14.3	5.09

* In total ration. † In experimental portion of ration.

Nos. 1. 2 and 4 Name of cow and period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
ELEANOR														
		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I.	No. 1	294.6	83.4	178.9	16.36	6.06	29.27	10.84	60.7	9.9	3.68	214.5	35.1	13.00
	"	551.9	161.6	331.3	16.73	6.41	55.43	21.22	60.0	10.0	3.85	205.0	34.3	13.13
II.	No. 2	279.8	82.1	159.5	16.50	6.25	26.31	9.97	57.0	9.4	3.56	194.3	32.1	12.14
	"	520.7	156.4	291.9	16.52	6.26	48.22	18.26	56.1	9.3	3.51	186.7	30.8	11.67
III.	No. 1	282.2	84.3	153.1	16.91	6.59	25.89	10.09	54.3	9.2	3.58	181.6	30.7	11.97
	"	535.7	160.9	315.9	16.29	6.09	51.46	19.24	58.9	9.6	3.59	196.3	32.0	11.96
IV.	No. 2	268.2	78.3	161.1	16.75	6.40	26.98	10.31	60.1	10.1	3.84	205.8	34.5	13.17
	"	519.4	153.0	300.9	16.73	6.40	50.34	19.25	57.7	9.7	3.71	196.7	32.9	12.58
V.	No. 1	246.6	83.8	162.3	16.75	6.51	27.18	10.57	65.8	11.0	4.28	193.7	32.4	12.61
	"	502.3	161.7	346.1	16.04	6.08	55.52	21.03	68.9	11.1	4.19	214.1	34.3	13.01
QUEENIE														
I.	No. 2	196.9	61.4	88.6	16.13	5.99	14.29	5.31	45.0	7.3	2.70	144.3	23.3	8.65
	"	364.2	117.1	161.0	16.42	6.34	26.43	10.21	44.2	7.3	2.80	137.5	22.6	8.72
II.	"	190.7	61.6	78.1	16.81	6.70	13.14	5.23	41.0	6.9	2.74	126.8	21.3	8.49
	"	357.8	116.5	144.7	16.29	6.31	23.57	9.13	40.4	6.6	2.55	124.2	20.2	7.83
III.	"	186.5	61.2	70.6	16.52	6.40	11.66	4.52	37.9	6.3	2.42	115.4	19.1	7.39
	"	366.7	120.5	118.6	16.23	6.28	19.25	7.45	32.3	5.3	2.03	98.4	16.0	6.18
LINNET														
I.	No. 2	189.0	57.1	109.9	16.43	6.30	18.06	6.92	58.1	9.6	3.66	192.5	31.6	12.12
	"	352.7	112.0	210.6	16.69	6.62	35.15	13.94	59.7	10.0	3.96	188.1	31.4	12.45
II.	No. 1	190.7	62.3	106.9	17.03	6.87	18.20	7.34	56.1	9.5	3.85	171.6	29.2	11.78
	"	356.8	120.7	201.4	16.48	6.64	33.20	13.37	56.4	9.3	3.75	166.9	27.5	11.08
III.	No. 2	184.9	57.9	100.9	16.44	6.30	16.59	6.36	54.6	9.0	3.44	174.3	28.7	10.98
	"	357.7	117.0	194.2	16.93	6.89	32.88	13.37	54.3	9.2	3.74	166.0	28.1	11.43
IV.	No. 1	186.8	60.5	104.6	16.94	6.94	17.72	7.26	56.0	9.5	3.89	172.9	29.3	12.00
	"	365.1	122.5	188.8	16.93	6.97	31.96	13.15	51.7	8.8	3.60	154.1	26.1	10.73
V.	No. 2	183.9	60.6	94.6	16.56	6.78	15.66	6.41	51.4	8.5	3.49	156.1	25.8	10.58
	"	392.4	115.8	186.5	16.16	6.57	30.13	12.26	47.5	7.7	3.12	161.1	26.0	10.59
FLORA														
I.	No. 4	297.8	84.2	240.8	13.54	4.45	32.60	10.71	80.9	11.0	3.60	286.0	38.7	12.72
	"	541.6	161.6	431.2	14.21	5.03	61.27	21.69	79.6	11.3	4.00	266.8	37.9	13.42
II.	"	266.4	84.1	229.9	13.97	4.88	32.12	11.21	86.3	12.1	4.21	273.4	38.2	13.32
	"	505.8	161.2	419.3	13.41	4.50	56.26	18.88	82.9	11.1	3.73	260.1	34.9	11.71
III.	"	260.0	83.8	188.3	13.72	4.74	25.83	8.93	72.4	9.9	3.44	224.7	30.8	10.66
	"	510.5	162.7	327.4	13.18	4.37	43.16	14.29	64.1	8.5	2.80	201.3	26.5	8.78
IV.	"	270.1	82.7	156.0	13.41	4.49	20.91	7.01	57.8	7.7	2.60	188.6	25.3	8.48
	"	488.9	159.2	288.2	13.44	4.66	38.73	13.42	58.9	7.9	2.75	181.0	24.3	8.43
V.	"	252.8	84.0	149.1	13.48	4.75	20.10	7.08	59.0	8.0	2.80	177.5	23.9	8.43
	"	475.3	159.2	284.7	13.34	4.62	37.97	13.15	59.9	8.0	2.77	178.8	23.9	8.26
ROSEL														
I.	No. 4	313.3	105.2	259.0	14.52	4.79	37.61	12.41	82.7	12.0	3.96	246.2	35.7	11.80
	"	573.1	200.2	435.0	14.60	4.93	63.52	21.43	75.9	11.1	3.74	217.3	31.7	10.70
II.	No. 1	292.2	105.5	225.7	14.65	4.97	33.07	11.22	77.2	11.3	3.84	214.0	31.3	10.64
	"	520.3	201.7	407.0	14.39	4.76	58.56	19.37	78.2	11.3	3.72	201.8	29.0	9.60
III.	No. 4	261.2	103.1	202.4	14.30	4.85	28.95	9.82	77.5	11.1	3.76	196.3	28.1	9.53
	"	527.6	204.5	370.6	14.45	4.97	53.56	18.42	70.2	10.2	3.49	181.2	26.2	9.01
IV.	No. 1	251.8	104.1	179.0	14.64	5.10	26.21	9.13	71.1	10.4	3.63	172.0	25.2	8.77
	"	454.3	204.2	307.5	15.25	5.45	46.89	16.76	67.7	10.3	3.69	150.6	23.0	8.21
V.	No. 4	244.5	105.0	156.3	15.21	5.34	23.78	8.35	63.9	9.7	3.42	148.9	22.6	7.95
	"	465.7	200.1	281.0	15.04	5.14	42.27	14.44	60.4	9.1	3.10	140.4	21.1	7.22

* In total ration. † In experimental portion of ration.

Nos. 1, 4 and 6 Name of cow and period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
JUANITA														
		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I.	No. 1	255.7	85.2	184.2	15.62	5.80	28.77	10.68	72.0	11.3	4.18	216.2	33.8	12.54
	"	418.3	139.6	280.9	15.97	6.09	44.84	17.10	67.2	10.7	4.09	201.2	32.1	12.25
II.	"	234.6	84.5	160.4	16.21	6.19	26.00	9.93	68.5	11.1	4.23	189.8	30.8	11.75
	"	438.2	162.1	287.5	15.70	5.84	45.15	16.80	65.6	10.3	3.83	177.4	27.9	10.36
III.	"	234.4	84.5	142.8	15.77	5.91	22.52	8.44	60.9	9.6	3.60	169.0	26.7	9.99
	"	456.5	164.5	281.2	15.63	5.79	43.94	16.27	61.6	9.6	3.56	171.0	26.7	9.89
IV.	"	246.0	83.2	131.5	16.05	6.02	21.10	7.92	53.5	8.6	3.22	158.1	25.4	9.52
	"	452.2	161.6	266.1	16.27	6.30	43.30	16.78	58.8	9.6	3.71	164.7	26.8	10.38
V.	"	222.9	83.9	139.3	15.95	6.10	22.21	8.49	62.5	10.0	3.81	166.0	26.5	10.12
	"	426.1	156.5	288.8	15.65	5.89	45.19	17.00	67.8	10.6	3.99	184.5	28.9	10.86
POMONA														
II.	No. 1	277.0	84.5	333.6	14.61	5.25	48.75	17.50	120.5	17.6	6.32	394.8	57.7	20.71
	"	492.2	162.1	652.8	14.14	4.84	92.27	31.61	132.6	18.7	6.42	402.7	56.9	19.50
III.	No. 4	254.6	83.9	306.7	13.73	4.60	42.12	14.11	120.5	16.5	5.54	365.8	50.2	16.81
	"	522.6	163.6	552.3	13.81	4.65	76.24	25.68	105.7	14.6	4.91	337.6	46.6	15.70
IV.	No. 1	270.8	83.2	276.9	13.81	4.87	38.25	13.48	102.3	14.1	4.98	332.8	46.0	16.20
	"	525.2	163.4	472.3	14.30	5.07	67.54	23.93	89.9	12.9	4.56	289.1	41.3	14.68
V.	No. 4	267.9	84.0	248.3	14.17	5.00	35.18	12.41	92.7	13.1	4.63	295.6	41.9	14.77
	"	492.2	160.1	456.7	13.76	4.72	62.84	21.56	92.8	12.8	4.38	283.4	39.3	13.47
MAYFAIR														
II.	No. 1													
	"	355.1	118.9	329.8	14.14	4.56	46.64	15.05	92.9	13.1	4.24	277.4	39.2	12.66
III.	No. 4	182.7	60.3	165.1	14.30	4.76	23.61	7.86	90.4	12.9	4.30	273.8	39.2	13.04
	"	364.6	122.7	308.7	14.08	4.49	43.48	13.85	84.7	11.9	3.80	251.6	35.4	11.29
IV.	No. 1	192.7	62.5	152.8	14.36	4.70	21.94	7.18	79.3	11.4	3.73	244.5	35.1	11.49
	"	366.0	121.7	274.5	14.94	5.19	41.02	14.25	75.0	11.2	3.89	225.5	33.7	11.71
V.	No. 4	187.2	62.2	135.1	14.61	5.03	19.75	6.79	72.2	10.6	3.63	217.2	31.8	10.92
	"	356.0	120.1	255.6	14.38	4.94	36.74	12.63	71.8	10.3	3.55	212.8	30.6	10.52
HALLOWE'EN														
II.	No. 4	282.5	84.1	256.2	14.22	4.75	36.43	12.16	90.7	12.9	4.31	304.7	43.3	14.46
	"	493.5	161.2	440.4	14.14	4.86	62.27	21.39	89.2	12.6	4.33	273.2	38.6	13.27
III.	"	263.1	83.8	217.0	14.30	4.90	31.02	10.63	82.5	11.8	4.04	258.9	37.0	12.69
	"	507.8	160.9	400.7	14.35	5.05	57.49	20.22	80.2	11.3	3.98	249.0	35.7	12.57
IV.	"	264.8	83.6	188.1	14.73	5.42	27.70	10.20	71.0	10.5	3.85	225.0	33.1	12.20
	"	499.3	160.1	332.4	14.60	5.40	48.52	17.94	66.6	9.7	3.59	207.6	30.3	11.21
V.	"	263.7	82.3	175.3	14.54	5.37	25.49	9.42	66.5	9.7	3.57	213.0	31.0	11.45
	"	494.1	157.5	352.3	14.09	5.04	49.64	17.74	71.3	10.0	3.59	223.7	31.5	11.27
INEZ														
II.	No. 6	283.3	85.4	338.4	14.73	5.35	49.84	18.10	119.4	17.6	6.39	396.3	58.4	21.20
	"	536.1	163.6	600.6	14.59	5.28	87.60	31.69	112.0	16.3	5.91	367.1	53.5	19.37
III.	No. 4	280.9	83.9	271.6	14.75	5.35	40.07	14.54	96.7	14.5	5.18	323.6	47.8	17.33
	"	541.0	163.6	508.6	14.80	5.41	75.26	27.50	94.0	13.9	5.08	310.9	46.0	16.81
IV.	No. 6	280.1	84.4	253.5	14.94	5.45	37.88	13.81	90.5	13.5	4.93	300.4	44.9	16.36
	"	544.8	162.1	447.3	15.29	5.78	68.38	25.87	82.1	12.6	4.75	276.0	42.2	15.96
V.	No. 4	272.0	83.9	202.1	15.42	6.00	31.17	12.12	74.3	11.5	4.46	240.9	37.1	14.44
	"	520.9	160.1	434.9	14.87	5.52	64.65	23.99	85.5	12.4	4.61	271.6	40.4	14.98

* In total ration. † In experimental portion of ration.

Nos. 1, 4, 5 and 6 Name of cow and period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
FRESNO														
		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I.	No. 4	295.2	84.2	320.5	13.17	3.90	42.21	12.50	108.1	14.3	4.23	380.7	50.1	14.85
	“	548.5	161.6	542.6	13.24	4.08	71.82	22.11	98.9	13.1	4.03	335.8	44.4	13.68
II.	No. 6	282.5	85.4	288.6	13.07	4.00	37.73	11.55	102.2	13.4	4.09	338.0	44.2	13.53
	“	528.8	163.6	520.3	13.08	3.93	68.11	20.44	98.4	12.9	3.87	318.1	41.6	12.49
III.	No. 4	280.1	83.9	228.7	13.35	4.30	30.52	9.83	81.7	10.9	3.51	272.6	36.4	11.72
	“	529.9	163.6	415.2	13.14	4.09	54.57	16.99	78.3	10.3	3.21	253.8	33.4	10.39
IV.	No. 6	280.5	84.4	230.1	13.05	4.00	30.02	9.21	82.0	10.7	3.28	272.6	35.6	10.91
	“	531.0	162.1	410.4	13.42	4.32	55.06	17.73	77.3	10.4	3.34	253.2	34.0	10.94
V.	No. 4	268.3	83.9	206.4	13.56	4.55	28.00	9.39	76.9	10.4	3.50	246.0	33.4	11.19
	“	517.3	160.1	416.2	13.40	4.41	55.79	18.36	80.5	10.8	3.55	260.0	34.8	11.47
JERSEY LILY 2nd														
I.	No. 4	227.7	84.2	118.7	16.86	6.65	20.01	7.89	52.1	8.8	3.47	141.0	23.8	9.37
	“	415.7	160.7	215.8	17.11	6.96	36.92	15.03	51.9	8.9	3.62	134.3	23.0	9.35
II.	“	212.4	83.2	109.6	17.22	7.00	18.87	7.67	51.6	8.9	3.61	131.7	22.7	9.22
	“	403.1	161.8	197.9	16.83	6.76	33.30	13.38	49.1	8.3	3.32	123.1	20.7	8.27
III.	“	206.5	83.8	95.1	16.59	6.60	15.78	6.28	46.1	7.6	3.04	113.5	18.8	7.49
	“	403.7	162.7	176.2	16.68	6.68	29.39	11.77	43.6	7.3	2.92	108.3	18.1	7.23
IV.	“	210.2	83.6	88.1	17.38	7.31	15.31	6.44	41.9	7.2	3.06	105.4	18.3	7.70
	“	390.4	158.3	157.8	16.78	6.82	26.48	10.76	40.4	6.8	2.76	99.7	16.7	6.80
V.	“	202.4	83.1	85.3	16.51	6.69	14.08	5.71	42.1	7.0	2.82	102.6	16.9	6.87
	“	393.9	160.1	183.1	16.06	6.43	29.41	11.77	46.5	7.5	2.99	114.4	18.4	7.35
STAR BRIGHT														
I.	No. 4	297.8	84.2	119.7	16.72	6.45	20.02	7.72	40.2	6.7	2.59	142.2	23.8	9.17
	“	551.0	161.6	218.7	16.83	6.64	36.81	14.51	39.7	6.7	2.63	135.3	22.8	8.98
II.	No. 6	280.8	85.4	121.6	16.58	6.46	20.16	7.85	43.3	7.2	2.80	142.4	23.6	9.19
	“	524.5	163.6	241.6	16.42	6.38	39.67	15.42	46.1	7.6	2.94	147.7	24.3	9.43
III.	No. 4	275.5	83.9	124.4	16.95	6.74	21.09	8.39	45.2	7.7	3.05	148.3	25.1	10.00
	“	523.2	162.7	245.2	16.81	6.65	41.22	16.31	46.9	7.9	3.12	150.7	25.3	10.02
IV.	No. 6	261.2	84.4	127.8	16.83	6.55	21.51	8.37	48.9	8.2	3.20	151.5	25.5	9.92
	“	480.6	158.6	226.2	17.29	6.94	39.11	15.70	47.1	8.1	3.27	142.6	24.7	9.90
V.	No. 4	247.6	82.2	100.4	17.90	7.45	17.97	7.48	40.6	7.3	3.02	122.1	21.9	9.10
	“	453.4	160.1	142.4	17.39	7.06	24.76	10.06	31.4	5.5	2.22	88.9	15.5	6.28
STEPHANIE														
I.	No. 5	296.4	82.5	227.5	14.21	4.54	32.36	10.33	76.8	10.9	3.49	275.7	39.2	12.52
	“	536.8	162.5	435.4	14.31	4.83	62.29	21.04	81.1	11.6	3.92	267.9	38.3	12.95
II.	“	266.3	85.0	217.1	14.43	4.96	31.33	10.78	81.5	11.8	4.05	255.4	36.9	12.68
	“	494.1	161.2	430.7	14.02	4.52	60.37	19.48	87.2	12.2	3.94	267.2	37.5	12.10
III.	“	262.4	84.7	219.3	13.99	4.50	30.68	9.87	83.6	11.7	3.76	258.9	36.2	11.65
	“	513.5	166.2	438.8	14.23	4.64	62.36	20.32	85.4	12.1	3.96	264.0	37.5	12.23
IV.	“	270.8	85.4	224.8	14.67	4.83	32.99	10.85	83.0	12.2	4.01	363.2	38.6	12.71
	“	504.4	155.4	393.8	15.13	5.23	59.57	20.61	78.1	11.8	4.09	253.4	38.3	13.26
V.	“	211.9	65.0	169.4	15.56	5.69	26.35	9.64	79.9	12.4	4.55	260.6	40.5	14.83
	“	507.9	159.8	328.8	14.78	5.06	48.59	16.65	64.7	9.6	3.28	205.7	30.4	10.42
LIZZIE HEXHAM														
I.	No. 5	284.2	85.2	233.9	14.49	4.78	33.88	11.17	82.3	11.9	3.93	274.5	39.8	13.11
	“	519.4	162.5	439.3	14.60	4.89	64.15	21.50	84.6	12.4	4.14	270.3	39.5	13.23
II.	No. 1	253.6	84.5	199.6	14.62	4.84	29.18	9.67	78.7	11.5	3.81	236.2	34.5	11.44
	“	493.5	162.1	320.1	14.98	4.91	47.94	15.72	64.9	9.7	3.19	197.5	29.6	9.70
III.	No. 5	260.2	84.7	145.8	15.51	5.10	22.61	7.43	56.0	8.7	2.86	172.1	26.7	8.77
	“	510.6	166.2	279.3	15.47	5.10	43.21	14.25	54.7	8.5	2.79	168.1	26.0	8.58

* In total ration. † In experimental portion of ration.

Nos. 1 and 5 Name of cow and period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
SANTA ROSA														
		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I.	No. 1	293.6	85.2	233.4	14.20	4.52	33.15	10.55	79.5	11.3	3.59	273.9	38.9	12.38
	“	532.6	161.6	427.7	14.08	4.58	60.23	19.54	80.3	11.3	3.67	264.7	37.3	12.09
II.	“	258.0	84.5	225.2	13.93	4.60	31.37	10.36	87.3	12.2	4.02	266.5	37.1	12.26
	“	493.2	160.3	422.8	13.49	4.23	57.04	17.88	85.7	11.6	3.64	263.8	35.6	11.15
III	“	265.7	83.6	207.7	13.48	4.24	28.00	8.81	78.2	10.5	3.32	248.4	33.5	10.54
	“	518.9	159.1	403.0	13.71	4.36	55.27	17.59	77.7	10.7	3.39	253.3	34.7	11.06
IV.	“	268.7	83.2	207.0	13.57	4.32	28.09	8.95	77.0	10.5	3.33	248.8	33.8	10.76
	“	528.5	163.4	384.5	14.13	4.79	54.34	18.41	72.7	10.3	3.48	235.3	33.3	11.27
V.	“	262.2	83.9	205.1	14.02	4.75	28.76	9.74	78.2	11.0	3.71	244.5	34.3	11.61
	“	510.9	161.7	392.2	14.03	4.76	55.04	18.67	76.9	10.8	3.66	242.6	34.0	11.55
YEMASSEE														
I.	No. 1	281.4	85.2	213.6	14.23	4.78	30.40	10.20	75.9	10.8	3.62	250.7	35.7	11.97
	“	527.8	161.6	379.1	14.54	5.05	55.12	19.13	71.8	10.4	3.62	234.6	34.1	11.84
II.	No. 5	265.6	85.0	207.2	14.33	4.90	29.69	10.15	78.0	11.2	3.82	243.8	34.9	11.94
	“	501.2	162.1	381.8	13.89	4.66	53.02	17.79	76.2	10.6	3.55	235.5	32.7	10.97
III.	No. 1	263.1	82.7	179.1	14.05	4.75	25.17	8.51	68.1	9.6	3.23	216.6	30.4	10.29
	“	494.7	160.0	347.9	14.33	4.93	49.87	17.14	70.3	10.1	3.46	217.4	31.2	10.71
IV.	No. 5	252.1	83.6	184.9	14.05	4.75	25.97	8.78	73.3	10.3	3.48	221.2	31.1	10.50
	“	468.6	159.0	324.1	14.02	4.75	45.42	15.38	69.2	9.7	3.28	203.9	28.6	9.67
V.	No. 1	236.7	83.2	155.2	14.37	5.05	22.31	7.84	65.6	9.4	3.31	186.5	26.8	9.42
	“	470.1	161.7	293.0	14.21	4.90	41.63	14.36	62.3	8.9	3.06	181.2	25.7	8.88
JANICE														
I.	No. 5	226.4	85.2	141.6	15.17	5.25	21.48	7.44	62.5	9.5	3.29	166.2	25.2	8.73
	“	415.8	162.5	263.3	15.58	5.55	41.02	14.61	63.3	9.9	3.51	162.0	25.2	8.99
II.	“	213.4	85.0	136.3	15.62	5.63	21.29	7.67	63.9	10.0	3.59	160.4	25.1	9.02
	“	396.5	162.1	248.0	15.31	5.52	37.98	13.68	62.5	9.6	3.45	152.4	23.4	8.44
III.	“	204.7	81.1	127.9	15.44	5.60	19.75	7.16	62.5	9.6	3.50	157.7	24.4	8.83
	“	402.2	166.2	261.2	15.34	5.43	40.06	14.18	64.9	10.0	3.53	157.1	24.1	8.53
IV.	“	169.4	55.2	111.8	16.82	6.50	18.80	7.27	66.0	11.1	4.29	202.6	34.1	13.17
	“	396.2	161.6	210.0	16.22	5.80	34.07	12.18	53.0	8.6	3.07	129.9	21.1	7.54
V.	“	202.1	85.5	95.8	15.81	5.59	15.15	5.36	47.4	7.5	2.65	112.0	17.7	6.27
	“	384.7	162.5	154.1	15.36	5.53	23.67	8.52	40.1	6.2	2.21	94.1	14.6	5.24
HAIDEE														
I.	No. 5	292.4	85.2	128.2	16.17	6.12	20.73	7.85	43.8	7.1	2.68	150.5	24.3	9.23
	“	539.1	162.5	223.3	16.46	6.41	36.75	14.31	41.4	6.8	2.65	137.4	22.6	8.81
II.	No. 1	274.2	84.5	108.8	16.44	6.32	17.89	6.88	39.7	6.5	2.51	128.8	21.2	8.14
	“	517.5	162.1	204.1	16.37	6.25	33.42	12.75	39.4	6.5	2.46	125.9	20.6	7.87
III.	No. 5	274.5	84.7	100.4	16.69	6.47	16.76	6.50	36.6	6.1	2.37	118.5	19.8	7.67
	“	520.1	161.6	165.3	16.81	6.58	27.78	10.87	31.8	5.3	2.09	102.3	17.2	6.73

* In total ration. † In experimental portion of ration.

VI. DIFFERENCE TABLES. (*a*) TOTALS OF DIFFERENCES; (*b*) PERCENTAGE DIFFERENCES

[Showing differences in experimental feeding between the average of the results of two periods on one ration (the second named in the following tables) and those actually obtained with another ration (the first named in the following tables) in the intervening period.]

(*a*) TOTALS OF DIFFERENCES

RATIONS	Periods represented	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
		lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
No. 1														
V. low to low..	1	+ 62.5		+ 15.3	−0.20	−0.09	+ 1.61	+ 0.54	− 5.7	−1.0	−0.35			
Low to v. low..	2	−118.6		− 55.6	+0.37	+0.14	− 7.06	− 2.57	+ 5.9	+1.1	+0.39			
V. low to med.	1	+ 99.9		+ 46.4	−0.25	−0.23	+ 5.75	+ 1.47	− 3.7	−0.7	−0.33			
Med. to v. low	2	−232.9		− 82.3	−0.70	−0.58	−14.56	− 6.32	+12.8	+1.5	+0.36			
Very low.......	3	− 3.0	+ 1.3	+ 23.3	−0.18	−0.26	+ 3.23	+ 0.76	+ 7.2	+0.9	+0.26	+ 43.6	+ 5.8	+ 1.05
Low	3	− 4.9	+ 0.5	− 19.0	−0.01	+0.09	− 2.82	− 0.78	− 3.0	−0.5	−0.12	− 25.0	− 4.4	− 1.11
Medium.........	3	− 9.6	+ 3.2	− 38.5	+0.28	+0.48	− 3.52	− 0.13	− 7.4	−0.8	+0.01	− 31.5	− 3.2	− 0.48
No. 6														
V. low to low	2	+ 84.7		+ 28.2	+0.12	−0.03	+ 4.39	+ 1.21	− 8.0	−1.1	−0.41			
Low to v. low	2	− 89.0		− 52.5	+0.47	+0.35	− 5.52	− 1.09	+ 4.8	+1.1	+0.53			
V. low to med.	2	+244.2		+ 55.3	+1.00	+0.49	+13.50	+ 5.50	−38.1	−4.2	−1.11			
Med. to v. low	1	−121.1		− 77.3	+0.45	+0.40	− 9.06	− 1.85	+ 7.5	+1.5	+0.72			
V. low..........	3	+ 23.7	− 0.1	− 92.7	+0.61	+0.38	−11.09	− 3.15	−23.6	−3.0	−0.89	−220.0	−26.7	− 7.42
Low.............	2	+ 10.1	− 1.0	− 11.3	+0.26	+0.16	− 1.02	− 0.22	− 4.0	−0.5	−0.12	− 10.1	− 0.7	− 0.05
No. 1 to No. 7..	4	+ 5.5	+ 9.9	+ 18.1	+0.16	−0.28	+ 2.86	− 0.78	+ 2.4	+0.5	0	− 7.1	− 0.8	− 1.19
No. 7 to No. 1..	4	− 20.9	− 9.1	−113.8	−0.04	+0.37	−15.23	− 2.92	−16.9	−2.4	−0.41	− 46.4	− 6.1	− 0.96
No. 1 to No. 1..	3	− 6.0	− 0.8	− 32.7	+0.14	+0.11	− 4.72	− 1.55	− 6.5	−1.0	−0.30	− 19.8	− 2.8	− 0.90
No. 7 to No. 7..	4	− 65.1	− 1.7	− 33.1	−0.50	−0.07	− 6.15	− 1.98	+ 5.2	+0.2	+0.06	− 15.1	− 3.1	− 0.95
Pulp to silage..	5	−401.1	−384.3	−276.4	+1.52	+1.53	−38.42	−11.78	− 5.6	−0.3	+0.33	+304.0	+47.9	+19.38
Silage to pulp.	4	+277.2	+290.5	+147.3	−0.87	−0.87	+19.40	+ 5.54	− 7.2	−1.3	−0.73	−275.5	−40.0	−14.76
Pulp to pulp...	6	− 44.9	− 21.0	− 49.7	+1.21	+0.77	− 3.54	− 0.38	− 3.9	+0.3	+0.35	− 7.6	+ 0.4	+ 1.10
No. 1 to No. 3..	3	+ 3.6	− 3.8	− 57.2	+0.42	+0.17	− 3.77	0.	−10.3	−0.8	−0.04	− 27.4	− 0.7	+ 0.32
No. 3 to No. 1..	4	+ 3.4	+ 6.9	− 22.0	+0.55	+0.62	− 3.20	− 0.41	−10.0	−1.3	−0.18	− 32.3	− 4.4	− 0.97
No. 1 to No. 1..	2	+ 15.7	+ 3.3	− 39.8	+0.43	+0.29	− 2.50	+ 0.34	−11.2	−1.1	−0.10	− 33.5	− 2.8	− 0.18
No. 3 to No. 3..	5	+ 1.6	+ 5.1	− 18.9	−0.68	+0.52	− 1.88	+ 0.08	− 7.8	−1.0	−0.17	− 19.7	− 2.5	− 0.35

RATIONS	Periods represented	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
		lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
No. 1 to No. 2..	4	− 19.7	− 20.0	− 59.7	+0.74	+0.30	− 7.68	− 2.80	− 9.5	−1.2	−0.40	− 12.6	− 0.8	− 0.14
No. 2 to No. 1..	5	+ 2.3	+ 25.8	− 1.9	+0.25	+0.41	+ 0.25	+ 0.57	− 0.9	−0.2	+0.24	− 35.6	− 5.6	− 1.87
No. 1 to No. 1..	1	− 2.4	+ 5.3	+ 24.4	−0.49	−0.19	+ 3.13	+ 1.04	+ 5.6	+0.7	+0.25	+ 11.9	+ 1.4	+ 0.47
No. 2 to No. 2..	4	− 18.4	− 5.6	− 17.5	+0.42	+0.31	− 1.59	− 0.20	− 1.0	+0.1	+0.11	− 3.7	+ 0.1	+ 0.35
No. 1 to No.*4..	3	+ 58.2	+ 4.7	+ 9.5	−1.24	−0.84	− 3.19	− 2.54	− 7.7	−2.1	−1.07	− 3.2	− 3.4	− 2.19
No. 4 to No. 1..	4	− 48.9	+ 3.2	− 53.9	+1.59	+1.09	− 2.10	+ 1.09	− 5.2	+0.5	+0.63	− 35.8	− 1.7	+ 0.72
No. 1 to No. 1..	3	+ 23.0	+ 63.3	− 8.0	+0.17	+0.08	− 0.80	− 0.26	− 5.3	−0.8	−0.27	− 21.9	− 3.2	− 1.19
No. 4 to No. 4..	3	− 11.2	− 0.3	− 4.3	−0.34	−0.25	− 2.13	− 1.27	+ 1.1	−0.2	−0.15	− 2.4	− 1.3	− 0.77
No. 4 to No. 6..	5	− 9.8	0.	+ 53.6	−0.23	+0.03	+ 9.78	+ 3.59	+11.7	+2.1	+0.79	+ 31.8	+ 6.1	+ 2.20
No. 6 to No. 4..	3	+ 21.1	+ 3.0	− 54.9	−0.30	−0.17	− 7.92	− 2.63	−12.4	−2.0	−0.64	− 37.0	− 5.5	− 1.89
No. 4 to No. 4..	5	+ 1.6	+ 0.5	− 51.5	+0.57	+0.36	− 6.24	− 1.82	−11.5	−1.6	−0.45	− 33.5	− 4.2	− 1.20
No. 1 to No. 5..	2	− 23.9	− 0.6	+ 21.9	−0.80	−0.49	+ 0.19	− 0.72	+ 8.0	+0.5	+0.03	+ 14.1	+ 0.1	− 0.43
No. 5 to No. 1..	3	− 23.8	− 2.9	− 34.5	+0.04	−0.07	− 3.94	− 1.45	− 4.5	−0.5	−0.15	− 18.0	− 2.0	− 0.72
No. 1 to No. 1..	3	− 11.0	+ 0.1	− 6.4	−0.25	−0.16	− 1.95	− 0.97	+ 0.6	−0.2	−0.11	− 4.2	− 1.3	− 0.62
No. 5 to No. 5..	6	− 27.2	− 3.7	+ 50.3	+0.31	+0.04	+ 3.19	+ 2.55	+15.6	+2.3	+0.81	+ 36.0	+ 5.7	+ 1.86
V. low to med..	1	+ 132.0		+71.12	+0.24	−0.02	+11.36	+ 3.29	−13.3	−1.5	−0.56			

*Note.—Serena's anomalous record included here. It is thrown out, however, when data are used in text. The record omitting this appears at foot of table.

(b) PERCENTAGE DIFFERENCES

RATIONS	Periods represented	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter					
									In entire ration			In experimental feed		
									Milk	Total solids	Fat	Milk	Total solids	Fat
		lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
No. 1														
V'y low to low	1	+13	....	+4	—1	—2	+3	+3	—8	—9	—9	....	....	....
Low to v'y low	2	—12	....	—8	+1	+1	—7	—7	+5	+5	+5	....	....	....
V. low to med.	1	+23	....	+16	—2	—5	+14	+10	—6	—7	—10	....	....	....
Med. to v'y low	2	—23	....	—14	—2	—5	—16	—20	+11	+9	+6	....	....	....
Very low	3	0	+1	+3	0	—2	+3	+2	+4	+3	+3	+2	+2	+1
Low	3	0	0	—2	0	+1	—2	—2	—2	—2	—1	—2	—3	—2
Medium	3	—1	+1	—2	+1	+3	—2	0	—2	—2	0	—3	—2	—1
No. 6														
V'y low to low	2	+10	....	+4	0	0	+4	+4	—5	—5	—5	....	....	....
Low to v'y low	2	—9	....	—7	+2	+4	—6	—3	+3	+5	+7	....	....	....
V. low to med.	2	+27	....	+6	+4	+6	+10	+13	—17	—14	—12	Note 1		
Med. to v'y low	1	—23	....	—16	+3	+9	—14	—9	+18	+12	+18	....	....	....
Very low	3	+2	0	—7	+1	+2	—6	—5	—8	—7	—6	—7	—6	—5
Low	2	+1	—1	—2	+1	+1	—1	—1	—3	—3	—2	—2	—1	0
No. 1 to No. 7	4	0	+1	+1	0	—1	+1	—1	+1	+1	0	—1	—1	—2
No. 7 to No. 1	4	—1	—1	—6	0	+2	—5	—3	—4	—4	—2	—4	—5	—2
No. 1 to No. 1	3	0	0	—3	0	0	—3	—3	—3	—3	—2	—3	—3	—2
No. 7 to No. 7	4	—3	0	—2	—1	0	—3	—3	+1	0	0	—2	—3	—3
Pulp to silage	5	—15	—37	—16	+2	+6	—15	—13	—1	—1	+2	+35	+39	+44
Silage to pulp	4	+14	+53	+10	—2	—4	+10	+9	—3	—3	—6	—28	—29	—31
Pulp to pulp	6	—1	—2	—2	+1	+2	—1	0	—1	0	+1	—1	0	+2
No. 1 to No. 3	3	0	—1	—5	+1	+1	—2	0	—4	—2	0	—3	—1	+1
No. 3 to No. 1	4	0	+1	—2	+1	+3	—2	—1	—3	—3	—1	—3	—3	—2
No. 1 to No. 1	2	+2	+1	—3	+2	+3	—2	+1	—5	—3	—1	—4	—3	—1
No. 3 to No. 3	5	0	+1	—1	—1	+2	—1	0	—2	—2	—1	—2	—2	—1
No. 1 to No. 2	4	—1	—3	—5	+1	+1	—4	—4	—4	—3	—3	—2	—1	—0
No. 2 to No. 1	5	0	+4	0	0	+1	0	+1	0	0	+1	—4	—4	—3
No. 1 to No. 1	1	0	+3	+11	—3	—3	+9	+8	+13	+11	+11	+8	+7	+6
No. 2 to No. 2	4	—1	—1	—2	+1	+1	—1	0	0	0	+1	0	0	+1
No. 1 to No. 4	3	+4	+1	+1	—3	—5	—2	—4	—3	—5	—8	0	—3	—6
No. 4 to No. 1	4	—3	0	—4	+3	+6	—1	+2	—2	+1	+4	—4	—1	+2
No. 1 to No. 1	3	+2	+2	—1	0	0	—1	—1	—3	—3	—3	—4	—4	—4
No. 4 to No. 4	3	—1	0	0	—1	—2	—2	—3	+1	—1	—2	0	—2	—3
No. 4 to No. 6	5	0	0	+3	0	0	+4	+4	+3	+4	+4	+3	+4	+4
No. 6 to No. 4	3	+1	+1	—4	—1	—1	—4	—4	—5	—6	—5	—5	—5	—5
No. 4 to No. 4	5	0	0	—4	+1	+1	—3	—2	—4	—4	—3	—4	—3	—3
No. 1 to No. 5	2	—2	0	+3	—3	—5	0	—2	+6	+3	0	+3	0	—2
No. 5 to No. 1	3	—2	—1	—4	0	0	—3	—3	—2	—2	—2	—3	—2	—2
No. 1 to No. 1	3	—1	0	—1	—1	—1	—1	—2	0	—1	—1	—1	—1	—2
No. 5 to No. 5	6	—1	0	+3	0	0	+3	+3	+4	+4	+4	+3	+3	+3
V'y low to med.	1	+32	....	+16	+2	0	+19	+17	—12	—10	—12	....	....	....

VII. RESULTS OF EXPERIMENTAL FEEDING ON DIFFERENT RATIONS

RATIONS	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter: In entire ration: Milk	Total solids	Fat	In experimental feed: Milk	Total solids	Fat	Ratio of percent of fat to percent of solids-not-fat
GRAIN FEED NO. 1. 69 days on each ration														
	lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
Low	1586		1085	14.61	5.24	158.64	56.92	68.5	10.0	3.58				1.79
Very low	1405		1014	14.80	5.33	149.97	53.79	72.3	10.7	3.83				1.78
Very low ± low	−181		− 71	+0.19	+0.09	− 8.67	−3.13	+ 3.8	+0.7	+0.25				−0.01
% differences	− 11		− 7	+ 1	+ 2	− 5	− 6	+ 6	+ 7	+ 7				− 1
GRAIN FEED NO. 1. 69 days on each ration														
Medium	1551		911	15.06	5.36	135.97	48.23	58.6	8.8	3.12				1.81
Very low	1218		782	14.91	5.24	115.66	40.44	64.1	9.6	3.35				1.85
Very low ± med.	−333		−129	−0.15	−0.12	−20.31	−7.79	+ 5.5	+0.8	+0.23				+0.04
% differences	− 21		− 14	− 1	− 2	− 15	− 16	+ 9	+ 9	+ 7				+ 2
GRAIN FEED NO. 1. 69 days on each ration														
Very low I	1192	121	684	15.46	5.76	105.24	39.17	57.3	8.9	3.28	56.55	86.7	32.41	1.68
Very low II	1189	122	707	15.40	5.67	108.47	39.93	59.7	9.2	3.37	58.00	89.0	32.76	1.72
II ± I	− 3	+ 1	+ 23	−0.06	−0.09	+ 3.23	+0.76	+ 2.4	+0.3	+0.09	+1.45	+2.3	+0.35	+0.04
% differences	0	+ 1	+ 3	0	− 2	+ 3	+ 2	+ 4	+ 3	+ 3	+ 3	+ 3	+ 1	+ 2
GRAIN FEED NO. 1. 69 days on each ration														
Low I	1581	244	897	15.18	5.70	137.16	51.12	56.8	8.6	3.20	36.90	56.1	20.99	1.66
Low II	1576	244	878	15.18	5.73	133.34	50.84	55.8	8.5	3.20	36.07	54.6	20.62	1.65
II ± I	− 5	0	− 19	0	+0.03	− 3.82	−0.78	− 1.0	−0.1	0	− 3.8	−1.5	−0.37	−0.01
% differences	0	0	− 2	0	+ 1	− 3	− 2	− 2	− 1	0	− 2	− 3	− 2	− 1
GRAIN FEED NO. 1. 69 days on each ration														
Medium I	1580	484	1598	14.55	5.01	226.60	75.27	100.2	14.0	4.55	327.4	46.0	14.93	1.90
Medium II	1571	487	1559	14.63	5.10	223.08	75.14	99.0	14.2	4.78	320.1	45.8	15.42	1.87
II ± I	− 9	+ 3	− 39	+0.08	+0.09	− 3.52	−0.13	− 1.2	+0.2	+0.23	− 7.3	−0.2	+0.49	−0.03
% differences	− 1	+ 1	− 2	+ 1	+ 2	− 1	0	− 1	+ 1	+ 5	− 2	0	+ 3	− 2
GRAIN FEED NO. 6. 92 days on each ration														
Low	1902		1530	14.04	4.65	214.98	71.21	81.1	11.4	3.75				2.02
Very low	1728		1450	14.13	4.74	205.07	68.91	84.3	11.9	3.99				1.98
V. low ± low	−174		− 80	+0.09	+0.09	− 9.91	−2.30	+ 3.2	+0.5	+0.24				−0.04
% differences	− 9		− 5	+ 1	+ 2	− 5	− 3	+ 4	+ 4	+ 6				− 2

RATIONS	Total dry matter eaten	Total dry matter eaten experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter						Ratio of percent of fat to percent of solids-not-fat
								In entire ration			In experimental feed			
								Milk	Total solids	Fat	Milk	Total solids	Fat	
	lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
GRAIN FEED NO. 6. 69 days on each ration														
Medium..........	1673		1536	14.05	4.54	215.91	69.72	91.9	12.9	4.16				2.09
Very low.........	1307		1404	13.87	4.51	193.35	62.37	107.1	14.8	4.78				2.08
Very low ± med.	−366		−132	−0.18	−0.03	−22.56	−7.35	+15.2	+1.5	+0.62				−0.01
% differences.....	− 21		− 9	− 1	− 1	− 10	− 11	+ 17	− 15	+ 15				0
GRAIN FEED NO. 6. 69 days on each ration														
Very low I.......	1474	123	1328	14.60	5.12	193.39	67.98	90.2	13.1	4.62	1081.7	157.7	55.36	1.85
Very low II......	1463	122	1267	14.66	5.14	185.10	64.93	86.2	12.6	4.42	1041.0	152.1	53.38	1.85
II ± I.........	− 11	− 1	− 61	+0.06	+0.02	− 8.29	−3.05	− 4.0	−0.5	−0.20	−40.7	−5.6	−1.98	0.00
% differences....	− 1	− 1	− 5	0	0	− 4	− 4	− 4	− 4	− 4	− 4	− 4	− 4	0
GRAIN FEED NO. 6. 46 days on each ration														
Low I............	876	159	501	15.22	5.63	76.09	28.11	57.2	8.7	3.22	313.9	47.8	17.63	1.70
Low II...........	872	161	499	15.18	5.59	75.73	27.87	57.3	8.7	3.20	309.7	47.0	17.29	1.71
II ± I.........	− 4	+ 2	− 2	−0.04	−0.04	− 0.36	−0.24	+ 0.1	0	−0.02	− 4.2	−0.8	−0.34	+0.01
% differences....	0	+ 1	0	0	− 1	0	− 1	0	0	− 1	− 1	− 2	− 2	+ 1
GRAIN FEEDS NOS. 1 and 7. 184 days on each ration														
No. 1.............	4065	1427	3777	14.24	4.99	529.27	182.41	92.7	13.1	4.57	266.0	37.8	13.14	1.85
No. 7.............	4081	1446	3909	14.26	4.91	547.26	184.55	95.1	13.5	4.61	271.0	38.4	13.12	1.90
No. 7 ± No. 1.	+ 16	+19	+132	+0.02	−0.08	+17.99	+2.14	+ 2.4	+0.4	+0.04	+ 5.0	+0.6	−0.02	+0.05
% differences....	9	+ 1	+ 4	0	− 2	+ 3	+ 1	+ 3	+ 3	+ 1	+ 2	+ 2	0	+ 3
GRAIN FEED NO. 5. 69 days on each ration														
No. 1 I...........	1255	491	979	15.84	5.98	154.88	58.36	77.9	12.4	4.65	199.5	31.6	11.90	1.65
No. 1 II..........	1232	483	910	16.12	6.29	146.61	57.03	74.0	11.9	4.64	188.8	30.4	11.82	1.56
II ± I.........	− 23	− 8	− 69	+0.28	+0.31	− 8.27	−1.33	− 3.9	−0.5	−0.01	−10.7	−1.2	−0.08	−0.09
% differences....	− 2	− 2	− 7	+ 2	+ 5	− 5	− 2	− 5	− 4	0	− 5	− 4	− 1	− 5
GRAIN FEED NO. 7. 92 days on each ration														
No. 7 I...........	1984	775	1886	11.75	3.58	217.37	64.96	94.8	10.9	3.26	237.8	27.5	8.24	2.28
No. 7 II..........	1936	769	1877	11.96	3.67	219.35	65.42	97.2	11.3	3.40	237.5	27.9	8.35	2.26
II ± I.........	− 48	− 6	− 9	+0.21	+0.09	+ 1.98	+0.46	+ 2.4	+0.4	+0.14	− 0.3	+0.4	+0.11	−0.02
% differences....	− 2	− 1	0	+ 2	+ 3	+ 1	+ 1	+ 3	+ 4	+ 4	0	+ 1	+ 1	− 1

RATIONS	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter						Ratio of percent of fat to percent of solids-not-fat
								In entire ration			In experimental feed			
								Milk	Total solids	Fat	Milk	Total solids	Fat	
	lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
SILAGE AND BEET PULP 207 days on each ration														
Silage	4271	1209	2853	14.58	5.26	405.54	142.21	66.8	9.5	3.36	238.2	34.4	12.28	1.77
Pulp	4949	1883	3277	14.31	5.01	463.36	159.53	66.2	9.4	3.25	173.8	24.6	8.49	1.86
Pulp ± silage	+678	+674	+424	−0.27	−0.25	+57.82	+17.32	−0.1	−0.1	−0.11	−64.4	−9.8	−3.79	+0.11
% differences	+ 16	+ 56	+ 15	− 2	− 5	+ 14	+ 12	0	− 1	− 3	− 2.7	−2.8	− 31	+ 6
BEET PULP. 138 days on each ration														
Pulp I	3047	1125	2140	16.13	6.06	343.16	128.19	70.3	11.3	4.25	190.5	30.7	11.49	1.65
Pulp II	3086	1171	2238	16.00	5.90	357.80	131.75	72.6	11.6	4.27	192.7	30.8	11.32	1.71
II ± I	+ 39	+ 46	+ 98	−0.13	−0.16	+14.64	+ 3.56	+2.3	+0.3	+0.02	+ 2.2	+0.1	−0.17	+0.06
% differences	+ 1	+ 4	+ 5	− 1	− 3	+ 4	+ 3	+ 3	+ 3	0	+ 1	0	− 1	+ 4
GRAIN FEEDS NOS. 1 and 3. 138 days on each ration														
No. 1	3136	1010	2744	15.00	5.52	387.91	132.94	79.8	11.5	4.00	253.7	36.2	12.57	1.72
No. 3	3136	999	2709	14.98	5.47	387.34	133.35	79.8	11.5	4.02	254.6	36.7	12.75	1.74
No. 3 ± No. 1	0	− 11	− 35	−0.02	−0.05	− 0.57	+ 0.41	0	0	+0.02	+ 0.9	+0.5	+0.18	+0.02
% differences	0	− 1	− 1	0	− 1	0	0	0	0	+ 1	0	+ 1	+ 1	+ 1
GRAIN FEED NO. 1. 46 days on each ration														
No. 1 I	1068	328	1334	13.47	4.42	179.51	58.81	124.9	16.8	5.51	407.0	54.5	17.95	2.05
No. 1 II	1072	325	1251	13.84	4.68	172.29	57.83	116.9	16.2	5.40	385.7	53.2	17.82	1.96
II ± I	+ 4	− 3	− 83	+0.37	+0.26	− 7.22	− 0.98	−8.0	−0.6	−0.11	−21.3	−1.3	−0.13	−0.09
% differences	0	− 1	− 6	+ 3	+ 6	− 4	− 2	− 7	− 4	− 2	− 5	− 2	− 1	− 4
GRAIN FEED NO. 3. 115 days on each ration														
No. 3 I	2588	799	1710	15.85	5.85	257.97	91.37	65.4	9.9	3.50	213.7	32.3	11.40	1.71
No. 3 II	2486	804	1716	15.90	5.92	254.23	88.39	67.0	10.0	3.48	212.2	31.5	10.95	1.69
II ± I	−102	+ 5	+ 6	+0.05	+0.07	− 3.74	− 2.98	+1.6	+0.1	−0.02	− 1.5	− 0.8	−0.45	−0.02
% differences	− 4	+ 1	0	0	+ 1	− 1	− 3	+ 2	+ 1	− 1	− 1	− 2	− 4	− 1
GRAIN FEEDS NOS. 1 and 2. 207 days on each ration														
No. 1	4281	1337	2480	16.70	6.59	413.66	162.28	57.5	9.6	3.79	183.4	30.6	12.04	1.53
No. 2	4259	1291	2422	16.75	6.59	405.73	158.91	56.5	9.5	3.73	186.1	31.2	12.23	1.54
No. 2 to No. 1	− 22	− 46	− 58	+0.05		− 7.93	− 3.37	−1.0	−0.1	− 0.06	+ 2.7	+0.6	+0.19	+0.01
% differences	− 1	− 3	− 2	0	0	− 2	− 2	− 2	− 1	− 2	+ 1	+ 2	+ 2	+ 1

RATIONS	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained 100 lbs. of dry matter						Ratio of percent of fat to percent of solids-not-fat
								In entire ration			In experimental feed			
								Milk	Total solids	Fat	Milk	Total solids	Fat	
	lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
GRAIN FEED NO. 1. 23 days on each ration.														
No. 1 I	518	157	224	15.48	5.58	34.05	12.20	42.5	6.5	2.32	141.1	21.5	7.70	1.80
No. 1 II	516	162	248	14.99	5.84	37.18	13.24	48.1	7.2	2.57	153.0	22.9	8.17	1.81
II ± I	− 2	+ 5	+ 24	−0.49	−0.19	+ 3.13	+1.04	+5.6	+0.7	+0.25	+11.9	+1.4	+0.47	+0.01
% differences	0	+ 3	+ 11	− 3	− 3	+ 9	+ 8	+ 13	+ 11	+ 11	+ 8	+ 7	+ 6	+ 1
GRAIN FEED NO. 2. 92 days on each ration														
No. 2 I	1922	586	1125	16.84	6.64	190.38	75.30	57.1	9.7	3.81	186.9	31.6	12.48	1.54
No. 2 II	1886	576	1072	17.04	6.77	183.81	73.42	55.6	9.5	3.79	182.3	31.2	12.45	1.52
II ± I	− 36	−10	− 53	+0.20	+0.13	− 6.57	−1.88	+1.5	−0.2	−0.02	− 4.6	−0.4	−0.03	−0.02
% differences	− 2	− 2	− 5	+ 1	+ 2	− 3	− 2	− 3	− 2	− 1	− 2	− 1	0	− 1
GRAIN FEEDS NOS. 1 and 4. 161 days on each ration														
No. 1	3222	1177	2683	14.64	5.06	390.48	134.80	82.7	12.1	4.16	234.4	34.1	11.77	1.89
No. 4	3330	1179	2747	14.23	4.78	389.39	131.17	82.4	11.7	3.92	239.0	33.8	11.35	1.98
No. 4 ± No. 1	+108	+ 2	+ 64	−0.41	−0.28	− 1.09	−3.63	−0.3	−0.4	−0.24	+ 4.6	−0.3	−0.42	+0.09
% differences	+ 3	0	+ 2	− 3	− 6	0	− 3	0	− 3	− 6	+ 2	− 1	− 4	+ 5
GRAIN FEED NO. 1. 69 days on each ration														
No. 1 I	1335	478	847	15.69	5.86	132.90	49.59	63.6	10.0	3.75	178.3	28.0	10.45	1.68
No. 1 II	1336	486	830	15.99	6.07	132.68	50.43	62.2	10.0	3.77	171.1	27.4	10.37	1.63
II ± I	+ 1	+ 8	− 17	+0.30	+0.21	− 0.22	+0.84	−1.4	0	+0.02	− 7.2	−0.6	−0.08	−0.05
% differences	0	+ 2	− 2	+ 2	+ 4	0	+ 2	− 2	0	+ 1	− 4	− 2	− 1	− 3
GRAIN FEED NO. 4. 69 days on each ration														
No. 4 I	1530	486	1013	13.38	4.52	135.94	46.00	66.0	8.9	3.00	208.5	28.0	9.47	1.96
No. 4 II	1492	481	1061	13.43	4.58	142.49	48.45	70.9	9.5	3.24	220.6	29.6	10.07	1.93
II ± I	− 38	− 5	+ 48	+0.05	+0.06	+ 6.55	+2.45	+4.9	+0.6	+0.24	+12.1	+1.6	+0.60	−0.03
% differences	− 2	− 1	+ 5	0	+ 1	+ 5	+ 5	+ 7	+ 7	+ 8	+ 5	+ 6	+ 6	− 2
GRAIN FEEDS NOS. 4 and 6. 184 days on each ration														
No. 4	4214	1300	2961	15.00	5.43	431.60	152.37	69.8	10.2	3.60	227.7	33.2	11.72	1.76
No. 6	4183	1297	3069	15.07	5.46	449.30	158.59	72.8	10.7	3.78	236.4	34.6	12.23	1.76
No. 6 ± No. 4	− 31	− 3	+108	+0.07	+0.03	+17.70	+6.22	+3.0	+0.5	+0.18	+ 8.7	+1.4	+0.51	0.00
% differences	− 1	0	+ 4	0	+ 1	+ 4	+ 4	+ 4	+ 5	+ 5	+ 4	+ 4	+ 4	0
GRAIN FEED NO. 4. 115 days on each ration														
No. 4 I	2221	807	1823	15.70	6.03	208.01	76.14	58.5	11.0	3.38	165.3	25.3	9.46	1.60
No. 4 II	2186	801	1252	15.88	6.18	198.59	73.82	55.8	10.7	3.33	156.4	24.2	9.21	1.57
II ± I	− 35	− 6	− 71	+0.18	+0.15	− 9.42	−2.32	−2.7	−0.3	−0.05	− 8.9	−1.1	−0.25	−0.03
% differences	− 2	− 1	− 5	+ 1	+ 2	− 5	− 3	− 5	− 3	− 1	− 5	− 4	− 3	− 2

RATIONS	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained 100 lbs. of dry matter						Ratio of percent of fat to percent of solids-not-fat
								In entire ration			In experimental feed			
								Milk	Total solids	Fat	Milk	Total solids	Fat	
	lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
GRAIN FEEDS NOS. 1 and 5. 115 days on each ration														
No. 1	2499	806	1556	14.88	5.20	229.48	79.50	62.4	9.2	3.18	193.2	28.5	9.87	1.86
No. 5	2499	808	1613	14.71	5.12	233.61	80.23	64.9	9.4	3.22	199.6	28.9	9.93	1.87
No. 5 ± No. 1	0	+ 2	+ 57	−0.17	−0.08	+ 4.13	+0.73	+ 2.5	+0.2	+0.04	+6.4	+0.4	+0.06	+0.01
% differences	0	0	+ 4	− 1	− 2	+ 2	+ 1	+ 4	+ 2	+ 1	+ 3	+ 1	+ 1	+ 1
GRAIN FEED NO. 1. 69 days on each ration														
No. 1 I	1560	480	1216	13.79	4.46	168.18	54.29	78.0	10.8	3.48	251.0	34.9	11.33	2.09
No. 1 II	1533	486	1211	13.81	4.51	167.07	54.44	79.2	11.0	3.56	249.6	34.5	11.21	2.06
II ± I	− 27	+ 6	− 5	+0.02	+0.05	− 1.11	+0.15	+ 1.2	+0.2	0.08	−1.4	−0.4	−0.12	−0.03
% differences	− 2	+ 1	0	0	+ 1	− 1	0	+ 2	+ 2	+ 2	− 1	− 1	− 1	− 1
GRAIN FEED NO. 5. 138 days on each ration														
No. 5 I	2703	970	1968	14.98	5.17	292.38	100.07	71.6	10.7	3.66	203.9	30.3	10.54	1.90
No. 5 II	2739	979	1949	15.08	5.20	288.27	98.28	69.5	10.4	3.52	198.1	29.4	10.02	1.90
II. ± I	+ 36	+ 9	− 19	+0.10	+0.03	− 4.11	−1.79	− 2.1	−0.3	−0.14	−5.8	−0.9	−0.52	0.00
% differences	+ 1	+ 1	− 1	+ 1	+ 1	− 1	− 2	− 3	− 3	− 4	− 3	− 3	− 5	0
GRAIN FEED NO. 6. 46 days on each ration (Note 1)														
Medium	1074		986	14.03	4.47	138.39	43.98	91.8	12.9	4.10				2.14
Very low	821		837	14.13	4.68	117.97	38.84	102.2	14.4	4.74				2.02
Very low ± med.	−253		−149	+0.10	+0.21	−20.42	−5.14	+10.4	+1.5	+0.64				−0.12
% differences	− 24		− 15	+ 1	+ 4	− 15	− 12	+ 11	+ 12	+ 16				− 6

NOTE EXPLANATORY OF VI "DIFFERENCE TABLES," (PAGES 577-578), AND VII "RESULTS OF EXPERIMENTAL FEEDING," (PAGES 579-582).

Although "difference tables" have been printed in the last eight reports, accompanied by full explanations of their meaning, they are so condensed from the data of Table V that explanatory notes seem still in order.

When a cow eats a certain ration during a feeding period, another during a second period, returning to the first ration for a third period, all three being of equal lengths, and, so far as may be, all other things being equal, it is fair to assume, and in the discussion of feeding experiments it is usually assumed, that the average of the results obtained during the first and third periods on the ration then fed is what would have been secured during the second period had the feeding continued on one ration. A comparison of this average with the results actually obtained with another ration serves to show the relative value of the different fodders and feeds. The *difference between these calculated averages and the actual results* form the "differences" which measure the relative values of the two rations.

The first comparison of the record of the cow Stella (page 564) is given in full to show more clearly just what is meant by the figures in the "difference tables."

Record of STELLA for the experimental portions of periods II, III and IV	Total dry matter eaten	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter In entire ration Milk	Weight of products obtained per 100 lbs. of dry matter In entire ration Total solids	Weight of products obtained per 100 lbs. of dry matter In entire ration Fat
	lbs.	**lbs.**	**%**	**%**	lbs.	lbs.	lbs.	lbs.	lbs.
Average of actual record for periods II and IV (very low rations)	408.9	440.8	13.86	4.48	60.86	19.54	108.0	14.9	4.78
Actual record for period III (medium ration)....	540.9	512.0	14.10	4.46	72.22	22.83	94.7	13.4	4.22
Record made upon medium ration ± the average of those made on very low ration	+132.0	+71.2	+0.24	—0.02	+11.36	+3.29	—13.3	—1.5	—0.56

The first horizontal line of figures shows the average of the records of dry matter eaten, and of milk, solids, and fat given, etc., obtained in the experimental portions of the second and fourth feeding periods, while the cow was eating the very low grain ration, (page 564). The second horizontal line of figures shows the actual records of dry matter, milk, etc., obtained during the experimental portion of the third period when she ate the medium grain ration, page 564). The third horizontal line shows the amounts, greater or less as the case may be, of dry matter eaten, milk given, etc., when the medium ration was fed as compared with the average of the records on the very low ration. These differences furnish a measure of the relative value of the two rations, it being assumed, as stated above, that the averages correctly indicate the consumption and production which would have occurred during the intervening period had the ration remained unchanged.

The figures in the third horizontal line in the above table, together with another set similarly obtained by comparing Serena's periods III and V (averaged) with IV, added, each column by itself, gave the tenth horizontal line in table (*a*) "totals of differences," (page 575) beginning 2 +244.2 +55.3 +1.00 +0.49, etc. The figures in table (*b*) "percentage differences"—which are the final results and measures of the relative worth of the various rations—are obtained by dividing the "total differences" by the total actual consumption (of dry matter) or production (of milk, solids, fat and the same proportionate to 100 pounds of dry matter eaten). Thus, for example, the calculated amount of dry matter eaten when the medium grain ration was fed to the cows mentioned above in the averages of the experimental portions of the periods given in couplets (Stella's II and IV, and Serena's III and V), was 1139.7 pounds. This is 244.2 pounds more than the amount actually eaten when the very low ration was fed (895.5 pounds). Division furnishes the percentage differences; 244.2 divided by 895.5, multiplied by 100 equals 27. The "percentage difference" is + 27, or, in other words, the cows when fed on the medium ration during the intermediate periods ate 27 percent more dry matter than presumedly they would have eaten had they continued on the very low ration at precisely the same time they did eat the scantier one. This figure (+27) leads the tenth horizontal line in table (*b*) "percentage differences," (page 577). Similar comparisons with the remaining items show the percent of excess or deficit of consumption or product resulting from the use of these two rations.

The outcome is also shown in a somewhat different manner in Table VII, "Results of Experimental Feeding on Different Rations," wherein the total products for each period and for each calculated period are added. Thus, for example, in the case of the cows Stella and Serena, each fed three periods, including 6 twenty-three-day experimental portions, a comparison of 69 days' feeding for one cow on each ration may be made and neither side of the comparison suffer from the effects of advancing lactation, this being equalized. The use of the data found in Table V, "Production Records," with the cows in question for the experimental portion of the periods stated below will give the equivalent of 138 days' feeding on a medium ration:

Stella; period III	23 days' feeding
Serena; period IV	23 days' feeding
Stella; the average of records of periods III and V on the medium ration; equivalent to what might reasonably have been expected to have been the result in periods II had the feeding on the medium ration been continued	23 days' feeding

Equivalent to 69 days' feeding on medium ration

Using the data on the very low ration, the following combination gives 138 days' feeding:

Stella; period IV	23 days' feeding
Stella; the average of records of periods II and IV on the very low ration; equivalent, etc., to period III on the very low ration	23 days' feeding
Serena; the average of records of periods III and V on the very low ration; equivalent, etc., to period IV on the very low ration	23 days' feeding

Equivalent to 69 days' feeding on low ration

This permits the calculation of the consumption and production of each cow on each ration for the self same days of the experimental portion of the periods other than the first and last used with each cow, thus affording an excellent and, usually, accurate measure of the relative worth of the two rations. The result of this comparison forms the table at the top of page 579, the medium ration figures beginning 1673, 1536, 14.05, and the very low ration data 1807, 1404, 13.87. The average percentages of total solids and fat are obtained by addition and not by cross division. This gives to each cow the same influence upon the final results instead of giving greatest preponderance to those yielding most largely of milk, solids and fat, and less to those giving smaller amounts.

It should be remarked, however, that as a matter of fact exact equality cannot always be obtained by the method of calculation last referred to. When a cow maintains her milk flow fairly well, little or no trouble is encountered. When, however, considerable shrinkage occurs, the side of the comparison which includes the record of the first period has, as a rule, the advantage. In other words, the figures derived from the means of the results of periods I and III, and III and V, and from the actual records of periods III and V, may have an advantage over those obtained from the means of the results of periods II and IV, and from the actual records of periods II and IV. This is due to the fact that the records of the first period, in which, often, the heaviest milk flow is given, helps on the one side of the comparison and not on the other. To be sure this side has also to carry the records of the last period, wherein, frequently, the smallest flow is given. Sometimes, but not always, these two tend to counterbalance. If the shrinkage is large in the last period, it is usually but not always thrown out of the experiment. The first period is seldom thus excluded, however; hence occasionally this condition is met.

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